TECHNICAL REPORT

76-45-OR/SA

THE CAMP EDWARDS EXPERIMENT IN BATTALION LEVEL CONSOLIDATED FIELD FEEDING

December 1975

UNITED STATES ARMY
NATICK RESEARCH and DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS 01760

Approved for public release; distribution unlimited.

Citation of trade names in this report does not constitute an official indorsement or approval of the use of such items.

Destroy this report when no longer needed. Do not return it to the originator.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TR 76-45 OR/SA
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE *(and Subtitle)*: THE CAMP EDWARDS EXPERIMENT IN BATTALION LEVEL CONSOLIDATED COMBAT FEEDING

5. TYPE OF REPORT & PERIOD COVERED:

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Steven Baritz
Ronald Bustead
Thaddeus S. Bonczyk (Cont on reverse)

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
US Army Natick Research & Development Command
Operations Research & Systems Analysis Office
Natick, MA 01760

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
6.2 - AD
1Y762724AH99A

11. CONTROLLING OFFICE NAME AND ADDRESS:
Operations Research & Systems Analysis Office
US Army Natick Research & Development Command
Natick, MA 01760

12. REPORT DATE: December 1975

13. NUMBER OF PAGES: 128

14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*:

15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Service Requirement Identification: USA 3-6 and USMC 3-3,
Field Feeding System

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Combat Feeding	Kitchen	Equipment	Food Distribution Center
Consolidation	System Effectiveness	Tent	
Field Feeding	Manpower Requirements	Maneuver Battalion	
Battalion	Food Service	XM-75 Kitchen	
Disposables	Operation	Sanitation Center	

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The results of a field feeding experiment demonstrated that a new consolidated feeding system (designated XM-75) operating at the battalion level can reduce the number of cooks and K.P.'s by 45% and 61%, respectively, when compared to company level kitchens. The experimental system included new food preparation equipment, electrically powered labor saving devices, new modular shelters and new sanitation equipment. A significant improvement in the performance of the system was achieved,
(Cont on reverse)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

7. Authors (Cont'd)

Mark M. Davis
Harry J. Kirejczyk
Herbert L. Meiselman
Gerald Silverman
Robert S. Smith
I.E. Stefaniw
Lawrence Symington

20. Abstract (Cont'd)

however, further testing is recommended to refine the kitchen design and prove a new distribution concept.

PREFACE

This report documents the results of the first in a series of three field feeding experiments which have been scheduled to evaluate new configurations of large consolidated kitchens for use by the Army and Marine Corps under field conditions. These experiments are designed to validate the results of a recent systems analysis[1] which projected a substantial savings of both food service personnel and kitchen attendants (KP's) in a typical Army division if large consolidated kitchens (battalion level) could be used in addition to small company kitchens. There is also a need to evaluate improved versions of a battalion level kitchen for the Marine Corps who are already using large capacity field kitchens.

This work is jointly sponsored by the Army and Marine Corps and is being conducted under the DOD Food Research Development Test and Engineering Program, Project No. 1Y762724AH99A.

The editor wishes to recognize General Del Torto, Commanding General of the 26th Infantry (Yankee) Division of the Massachusetts Army National Guard, and his staff, without whose support the experiment would not have been possible. Personnel of the participating units; the 101st Engineer, the 126th Signal and the 114th Medical Battalions are also recognized for their outstanding cooperation and support. Specifically, acknowledged are Lt. Col. Jordan, Major Encarnacao and CW 4 Joseph Gately of the 101st Engineer Battalion; Lt. Col. McSweeney of the 126th Signal Battalion and Lt. Col. Creamer and Mr. James McKenna of Camp Edwards who provided invaluable assistance in the extensive preliminary planning and execution of the experiment.

The editor also wishes to recognize the following Natick Research and Development Command personnel, who made a significant contribution to the experiment:

Paul S. Andricak	Food Engineering Laboratory
Domenic Bumbaca	Food Engineering Laboratory
David B. Corfield	Food Engineering Laboratory
Ronald L. Deacon	Operations Research/Systems Analysis Ofc
James Gallop	Food Engineering Laboratory
Cornelius J. McKeown	Aero Mechanical Engineering
Richard Morgan	Food Engineering Laboratory
Donald J. Munsey	Food Sciences Laboratory
Ivor J. Nii	Food Engineering Laboratory
Richard Rothberger	Operations Research/Systems Analysis Ofc
Ernest E. Saab	Aero Mechanical Engineering Laboratory

[1]Smith, R.S., et. al., "A System Evaluation of Consolidated Field Feeding for the Army," Technical Report 75-83 ORSA, US Army Natick Development Center, February, 1975

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Recently, a systems analysis was performed as part of a NARADCOM program to identify short term improvements which can be made to the Army's existing system of food service in the field. One of the most important of these improvements concerns significant reductions in the number of food service personnel required to operate the system.

A primary purpose of the systems analysis was to determine the feasibility and manpower reduction potential within the Army's present field feeding system through consolidation. Using an approved scenario involving four divisions, a plan for kitchen consolidation was developed. The net result of this consolidation was a reduction in the number of kitchens in a typical Army division from 115 to 50. These 50 kitchens would range in size from 68 to 988 consumers. However, only ten of these 50 would be of the large consolidated variety while the remainder would be much smaller. In fact, over half of the 50 kitchens would have capacities of less than 200. The level of consolidation proposed is shown in Table 1.

The personnel reductions and cost savings which could be achieved through the proposed consolidation were: (1) a 40% reduction in food service personnel; and (2) up to a 58% reduction in kitchen attendants (KP's).

As a result of information and data already available from previous work, it was anticipated that consolidated field feeding operations of this magnitude would create conditions and requirements never before experienced with either the M-1948 kitchen tent or new Mobile Kitchen Trailer (MKT) since these kitchens are designed to feed small company size units. NARADCOM, therefore, recommended that no final decision on consolidation be made by the Army until field feeding experiments[2] could be conducted to verify: (a) the feasibility of the concept; (b) projected personnel savings; and (c) to evaluate new equipment items which were considered necessary for successful implementation.

Based upon this recommendation and other supporting recommendations within the Army and Marine Corps, three field feeding experiments have been scheduled to validate this new concept at the following locations:

- Camp Edwards, MA with the Army National Guard
- Camp Pendleton, CA with the Marine Corps
- Fort Hood, TX with the Regular Army

---

[2] Op. cit. 1

TABLE I

CONSOLIDATION SUMMARY

KITCHEN REQUIREMENTS BY CAPACITY FOR ARMOR, INFANTRY, AND MECHANIZED DIVISIONS

Capacity of Kitchens	Armor Div	Inf. Div (M)	Inf. Div
100	19	19	21
200	9	8	6
300		1	2
400	10	10	10
500			
600	6	4	1
700	1	1	
800			7
900	5	5	1
1000			1
TOTAL*	50	48	49

*Number of kitchens per division

It should be noted that the Ft. Hood experiment is being sponsored by the Quartermaster School under Project MASSTER.

The purpose of this report is to document the results of the first experiment which was designed and conducted to evaluate a new battalion size kitchen designated the XM-75 (see Figure 1). This experiment was conducted during the period 9-22 August 1975 at Camp Edwards, MA with elements of the 101st Engineer Battalion, the 126th Signal Battalion, and the 114th Medical Battalion. These units, organic to the 26th Infantry (Yankee) Division of the Massachusetts Army National Guard, were undergoing their annual active duty training.

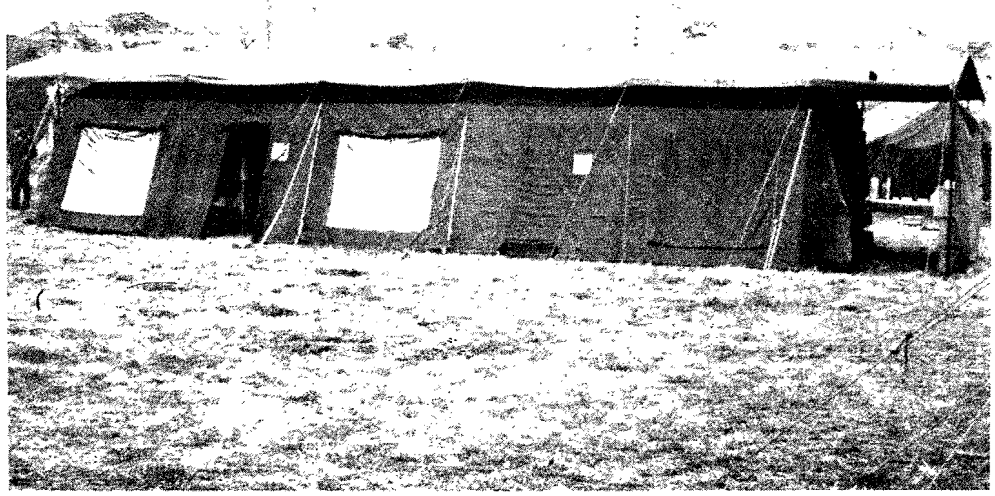


Figure 1. XM-75 Kitchen

CHAPTER II

SUMMARY REPORT

The objectives of this experiment were to:

- Determine the potential personnel savings associated with a new, large consolidated field feeding system designated the XM-75.

- Evaluate the performance of the new system including the shelters and associated kitchen equipment.

- Determine the effect of disposable trays and utensils on food service attendant (K.P.) manpower as well as consumer acceptability.

- Assess consumer acceptability of the food prepared in the XM-75 kitchen as well as menu changes designed specifically for field feeding.

It is important to note that the objectives of the experiment were limited due to the fact that the consumers were National Guardsmen undergoing annual training. Therefore, some of the implications of the concept for consolidation contained in the earlier report could not be evaluated and will require subsequent experimentation. These include:

(a) A direct comparison between all aspects (staffing levels, quality, sanitation, etc.) of the existing company system of feeding with the new consolidated XM-75 system.

(b) The provisions of food service in the Division rear by means of an area kitchen concept where certain units do not have organic kitchens. Therefore, these units would have their hot meals provided by area kitchens operated by food service companies assigned to the Division headquarters.

(c) An evaluation of methods by which individual companies on the FEBA pick up prepared food at a staging area (combat trains) and distribute it to their units without any assistance from the consolidated kitchen.

(d) The ability of certain units to consolidate effectively given their mission and location.

Description of the Experiment

This experiment was designed to place a maximum workload on the new XM-75 battalion level kitchen. To accomplish this, a menu was devised based on the use of the A-Ration components and it was planned to provide three hot meals each day. Consumers were served both at the kitchen site and in remote areas. Units in the field were supplied prepared food packed in the standard insulated food containers. A total of 864 consumers were involved consisting of personnel from eight different

National Guard companies (seven of these companies had organic kitchens). These companies would normally have been provided their food by individual kitchens dedicated to each company. This experiment, therefore, represented a seven for one consolidation.

As previously mentioned, new conditions and requirements which would dictate either modifications to existing equipment or addition of new equipment were anticipated for the battalion level kitchen. Because both the M-1948 kitchen tent and the standard general purpose medium tent are considered inadequate for battalion kitchen shelters, a new shelter was designed and fabricated. A new sanitation center, housed in a smaller expandable frame type shelter was also provided for pot and pan washing. Other non-standard field equipment included griddles, steam tables, sinks, vegetable and meat slicers, work tables, a high pressure sprayer, and a field water heater with pump which are designed to improve the efficiency of the operation.

An aspect of the experiment with which the reader should be familiar concerns factors which resulted in it being a "worst case" situation. The reasons for this include:

- Three "A-ration" meals were prepared and served daily. This represents the maximum workload which could be placed on the systems since in combat, individual operational rations would normally be served for lunch. Therefore, the kitchen would only have to prepare the breakfast and dinner meals allowing approximately a four-hour break in-between.

- The food service personnel who staffed the kitchen belonged to seven different companies from three different battalions. Only two of the cooks assigned to the experimental kitchen had ever worked together before.

- None of the food service personnel involved ever had any previous experience in consolidated field feeding and it was a totally new concept to all of them. Therefore, it was necessary for them to undergo a training period for the first two days of operation.

Data Collection Requirements

A variety of data were required to evaluate the battalion level concept of food service. The major types of data that were necessary and were collected during the experiment included:

Work Sampling - Work Sampling data were collected for all personnel assigned to the kitchen. These data were collected to provide the basis for determining the most reasonable staffing level for each category of worker.

Food Acceptance - All units at Camp Edwards were supplied prepared food from one consolidated kitchen rather than the seven smaller company level kitchens which would have normally been employed. Consumer surveys designed to measure food quality and quantity and serving temperature

were administered throughout the experiment. Some of these surveys asked consumers to rate the experimental food to the food they would normally receive from their company kitchens.

Mess Equipment - Surveys were administered to the consumers which were designed to measure customer preference and the advantages and disadvantages associated with the standard metal mess gear, disposable and non-disposable trays and utensils, paper plates and paper cups.

Human Engineering - These surveys were administered to the food service workers to measure their attitudes towards a large consolidated field kitchen and to evaluate the adequacy of the work space, equipment, and equipment layout from a human factors standpoint.

Microbiological - During the experiment, microbiological and food temperature data were gathered to measure kitchen and mess kit food preparation, and food handling sanitation levels. These data provided the basis for necessary corrective actions during the experiment. This information will also provide a future data base for use in comparing the sanitation level of the XM-75 system with both existing company level as well as battalion level kitchens.

Results and Conclusions

Based on the data and information gained through the experiment, the following results and conclusions are offered:

1. When serving three hot meals to 864 troops at one location, the use of the XM-75 system can reduce the number of cooks and K.P.'s by 45% and 61%, respectively, as compared to conventional company level kitchens.

2. The XM-75 system as staffed and equipped during the experiment, had more than sufficient capacity to serve 864 troops three hot meals per day when all consumers are served either at the kitchen site or in remote areas.

3. Preparation and delivery of three hot meals per day at both the kitchen site and forward areas under field conditions with the XM-75 kitchen represents such a heavy workload that the system and staffing being recommended would require personnel and equipment augmentation for prolonged operation. A more realistic meal discipline would be a hot breakfast and supper with the noon meal being an operational ration (Meal Combat Individual or equivalent).

4. The total sanitation workload resulting from a kitchen of this size is so great that a sanitation center equipped with field sinks is considered essential for proper sanitation and to achieve the maximum reduction in K.P. personnel.

5. The introduction of electrical power and a limited number of new items of equipment in the XM-75 system are highly desirable to achieve maximum reductions in personnel.

6. The performance of the XM-75 system (shelter and equipment) is considered superior by food service workers to the standard M-1948 kitchen although further refinements were identified during the experiment and are being incorporated into some of the new items of equipment.

7. The XM-75 system will require additional space for storage of insulated food containers and dry goods.

8. The current practice of daily rotational assignments to KP's is unacceptable in battalion kitchens. KP's must either be eliminated (apprentice cooks would replace them) or their tour of duty extended to at least a seven day period.

9. The use of disposable trays and utensils reduces the requirement for KP personnel by at least three personnel due to the elimination of the mess kit laundry lines.

10. The use of mess kits is considered unacceptable by consumers. By contrast, disposable trays and utensils are considered vastly superior to mess kits.

11. The XM-75 system is capable of providing hot meals at least as acceptable as the conventional company level kitchens.

CHAPTER III

GENERAL SYSTEM DESCRIPTION

Discussion

As previously mentioned, new conditions and requirements would prevail for a field kitchen that had to operate at a battalion level. Fortunately, however, the existing design of the company size kitchens used by the Army contained many components which were of modular design and when increased food preparation was required, as in a battalion kitchen, the only required change was to add more units (e.g., range cabinets, burner units, utensils, etc.). These types of components, therefore, could function equally well at the battalion level. Nevertheless, there were some equipment deficiencies which occurred when the kitchen operation was scaled up to the battalion level. (For example, the provision of an adequate kitchen shelter; equipment to keep prepared food hot on the serving line; and a means for efficiently performing the required sanitation). Anticipating these deficiencies, a number of changes to the system including new items of equipment were incorporated into this experiment. The major elements of the system were:

- XM-75 Kitchen
- Sanitation Center
- Food Distribution Center

Each of these major elements will be discussed below in terms of their function and the type and amount of equipment. In addition, a detailed discussion on the performance of the various commercial and non-standard items of equipment employed during the experiment is contained in Appendix A.

System Details

A new XM-75 battalion level feeding system was designed which provided for maximum use of standard components and anticipated problems by using modified standard components and new components. This system was designed to prepare and serve hot meals to approximately 1000 troops either at the kitchen site or at remote sites. The design layout and operation were established to keep food quality high while at the same time significantly reducing staffing levels.

Because both the M-1948 kitchen tent and the standard General Purpose Medium Tent were considered inadequate for battalion kitchen shelters, a new shelter, designated the XM-75, was designed, fabricated and used. This shelter was adapted from a standard Army expandable frame type tent and modified to provide improved ventilation and access by personnel. A new sanitation center, housed in a smaller expandable frame type shelter was also designed, fabricated, and used for pot and pan washing. Other nonstandard

field kitchen equipment used and evaluated included griddles and steam tables heated with the standard M-2 burner; sinks; vegetable and meat slicers; work tables, high pressure sprayer; and a field water heater with pump. It should be noted that all of this equipment is considered to be of the product improvement or low-cost, low-risk variety. All of these items were either commercially available or fabricated in-house in less than 60 days time. Furthermore, all new items of equipment were considered to be sufficiently unsophisticated that they could be introduced into the system without extensive research, development, and testing.

XM-75 Kitchen

The kitchen was housed in an expandable frame type shelter which initially utilized four sections, each 16'W x 8' L, making the complete shelter 16'W x 32'L. Two doorways were provided at each end of the tent, one for the entrance and the other for the exit of customers. The two end sections had a large window on each side while the two middle sections had a doorway on each side. Each window was screened and had a clear plastic covering with velcro closures that could be rolled down for inclement weather. Each door also had a screen with velcro closures and could be rolled up when not required. The roof of each section had a large screened vent on each side of the ridge pole to permit the hot air and gas fumes to escape. Protection from the sun was provided by a fly which covered the entire top of the tent. Dynel was used for all fabric material including vent, window and door coverings for use under blackout conditions or extremely inclement weather conditions.

Two serving lines were set up widthwise, one at each end of the tent to speed the flow of customers. Each of these lines was arranged such that it began with a three-shelf stainless steel table four feet in length for beverage jugs and disposable mess gear. This was followed by three identical tables (without the top shelf) on which were mounted steam tables and/or griddles (the number of griddles or steam tables utilized was dependent on the number and type of items on the menu.) Finally, another four-foot table, which was used for the bread and dessert products, completed the line.

The center area of the kitchen was the location where all food preparation and cooking were performed. Ten standard field ranges and two four-foot stainless steel tables were located here. A layout of the kitchen is shown in Figure 2.

After just three days of use, the layout of the XM-75 kitchen, as shown in Figure 2. was found to be unsatisfactory for the following reasons:

1. The overall work space was inadequate. The area between the two serving lines was limited and extremely crowded and cooks often got into each others way and bumped into hot range cabinets. Aisles were almost completely blocked when the range cabinet doors were opened. Only two work tables could be set up due to the limited space.

2. The serving lines were too short. Each line was only long enough to accommodate a combination of one/two griddles and one/two steam tables.

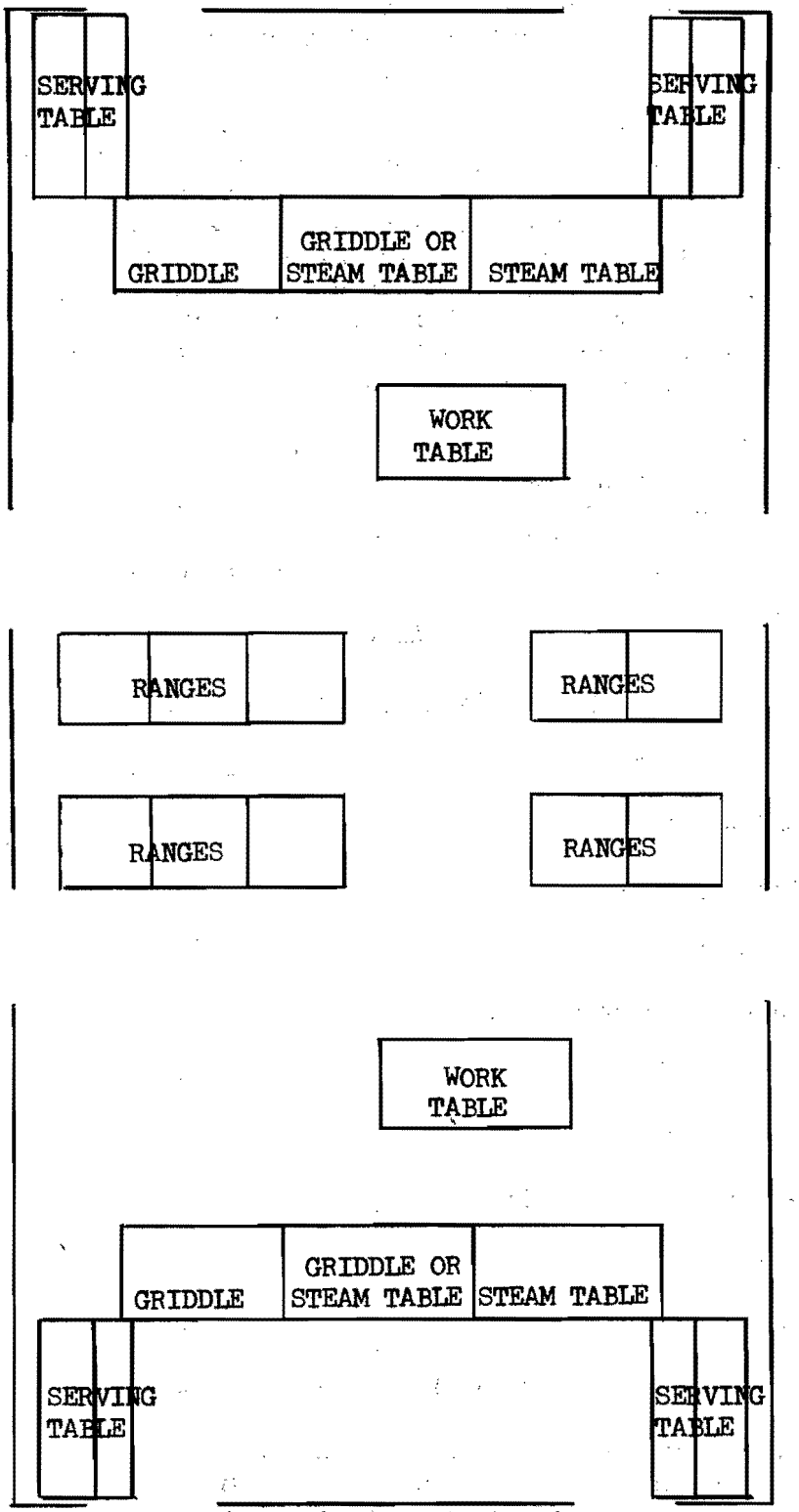


Figure 2. XM-75 Kitchen Layout (16'x 32' Shelter)

As a result, the lines had to be repeatedly modified to provide the appropriate combination of griddles and steam tables to accommodate the items on the menu.

3. The serving lines were located at opposite ends of the tent. As a result, when one serving line was shut down, the food in hot squarehead pans used for serving had to be transferred from the closed line to the open line at the opposite end of the tent where the food was being served. This same procedure was also followed when two serving lines were operating and one of the lines required immediate replenishment of food. As a result of the serving line locations, food in hot squarehead pans was often transferred back and forth between serving lines, a very unsatisfactory arrangement from a standpoint of work flow.

Revised Kitchen Layout - The foregoing problems created a need to expand the kitchen to provide additional work space. This was accomplished by means of one additional section at the center of the shelter making it 40 feet in length. A layout of the expanded kitchen is shown in Figure 3. A listing of the equipment utilized in the kitchen is provided in Table II.

TABLE II

Equipment List for XM-75 Kitchen

Item	Quantity
Field Range	10
Accessory Outfit	5
M-2 Burner	18
Insulated Beverage Jug	4
Lettuce Cutter	1
Tomato Slicer	1
Stainless Steel Table	6
Steam Table	4
Griddle	4

A description of the revised kitchen layout follows:

Each of the serving lines had disposable trays and utensils placed on a table at the beginning. Next, were two steam tables designed to hold two squarehead pans each. Heat for the steam table was supplied by one and sometimes two M-2 burners. Each steam table required approximately five gallons of water and was capable of maintaining two food items at 140°F to

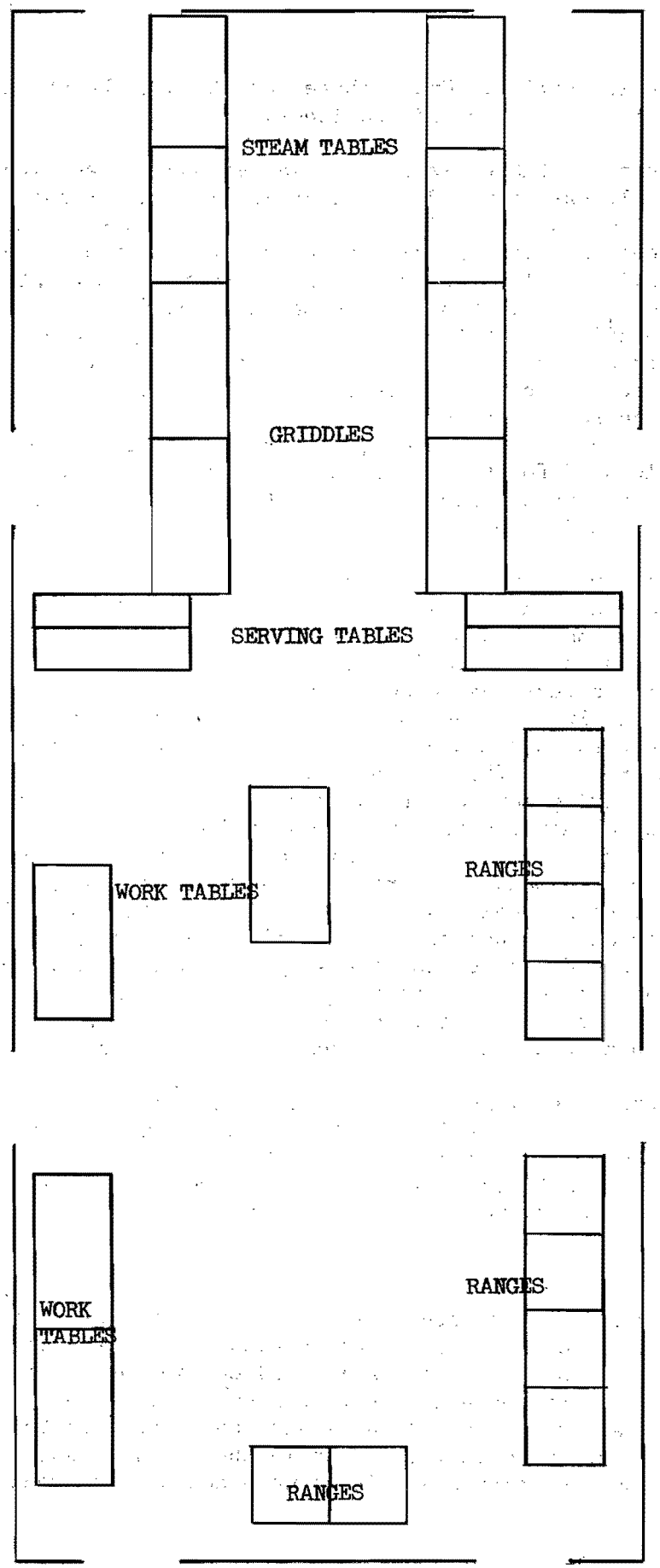


Figure 3. XM-75 Kitchen Layout (16' x 40' Shelter)

150°F during the serving period. Under these conditions, the steam table not in use was converted to serve chilled items.

Adjacent to the steam tables were two griddles made of anodized aluminum. Each griddle was provided with a drain slot and grease catcher. Heat for each griddle was also supplied by two M-2 burners. Protective splash guards and heat shields were placed on both the serving line side and ends of the griddle. Shields were also provided for the front side of each griddle to reduce the amount of heat escaping toward the cook. Between the griddles was a manifold with two stacks for exhausting hot air and fumes. These stacks transferred most of the heat coming off the bottom of the griddles from the kitchen area to the vents above. During meals where the griddles were not required, they served as a table top for serving salads, salad dressing, desserts, etc. At the end of each serving line was a stainless steel table used for the placement of insulated beverage jugs and the storage of bread and pastry products. A detailed layout of the serving line is shown in Figure 3.

During the second week, when the serving lines were set up parallel customers could enter through the two end doors and exit through the side doors. During peak periods with both lines in use, a serving rate of 16 customers per minute was maintained for periods of up to 15 minutes duration. This serving line arrangement was found to be very efficient for the following reasons: (a) If one line ran out of a particular item, the server simply had to turn to the other line to replenish his supply until additional food was prepared; (b) When one line was shutdown, (usually about halfway through the serving period) the servers on the open line could easily reach over and obtain the food that remained on the closed line as they ran out of each item; and, (c) When only one line was open the second line could be utilized for holding extra food hot so that the emptied containers could be rapidly replaced, as required. The tables used for the serving lines can all be knocked down for efficient packing and storage when movement of the field kitchen is necessary. It should be noted that all nonstandard equipment used on the serving lines consisted of commercially available items. Additional observations from the food service workers survey concerning the kitchen are presented in Chapter X.

The remaining three sections of the shelter were utilized for cooking and food preparation purposes. This area contained the ten range cabinets and four stainless steel work tables. The electric meat slicer was located on one of the work tables while the commercial lettuce cutter and tomato slicer were on another work table.

Work Space Design

The available work area was considered adequate with the parallel serving lines since they utilized only two sections of the shelter leaving the remaining three sections for preparation and cooking activities. It is interesting to note that the parallel serving lines arrangement contained two griddles and two steam tables. As a result, no changes to the serving line were required to accommodate variations in the menu. Also, the range cabinets were now positioned so aisles were not blocked when the

range cabinet doors were opened. The increased floor space was sufficient to accommodate two additional work tables while still providing adequate walk space for the cooks.

XM-75 Sanitation Center

The sanitation center was utilized for washing and sanitizing pots, pans, insulated food containers, and utensils. It was housed in an expandable frame type tent of the same basic design as the kitchen, measuring 16' x 16' and containing equipment listed in Table III.

TABLE III

XM-75 Sanitation Center Equipment List

Item	Quantity
Field Kitchen Sink	3
Drain Table	1
Wire Shelving	4
Shelving Upright (Shelving Support)	1
Pallets, flooring	6

The three field kitchen sinks were developmental items made of stainless steel and supported by standard cooking racks. Water for the sinks was heated by M-2 burners which slid into racks under each sink. Each sink had a drain hole with a hose so the water could be drained either outside or directly into a nearby sump (the sanitation center was located over a storm drain permitting easy disposal of the dirty water). Items requiring washing were placed either on the drain table or a pallet outside. The drain table led into the first sink, used for washing, while the second and third sinks were used for rinsing. Clean items were placed upon the wire shelving to dry.

Pallets were placed under the drain table and the three sinks so that workers would not have to stand in mud. Figure 4 depicts the layout of the sanitation center.

Food Distribution Center

A General Purpose Medium Tent was used as a shelter for the food distribution center. The functions of the food distribution center included: (a) processing of orders for food to be distributed to the field; (b) assisting in the filling of the insulated food containers; (c) loading the filled containers on vehicles for delivery of food to

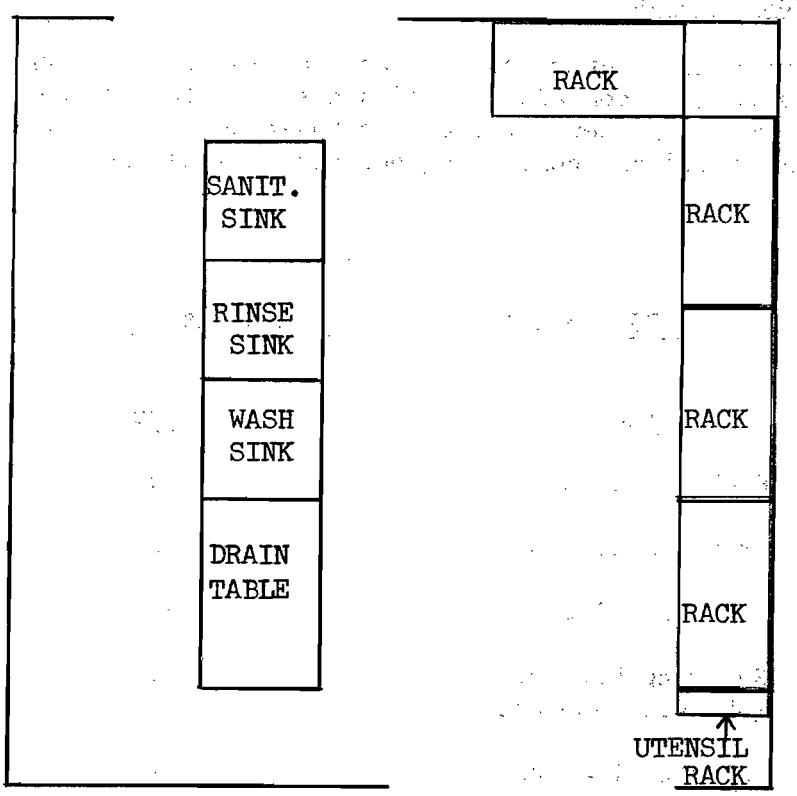


Figure 4. Layout of Pot Tent

the field; and (d) storing clean food containers, utensils and condiments. The equipment required is listed in Table IV.

TABLE IV

Food Distribution Center Equipment

Item	Quantity
Wire Shelving	1
Folding Table	2
Insulated container with inserts	50

The wire shelving was utilized for storing clean food container inserts. Each shelf was capable of holding 40 inserts. One table was used for administrative purposes and for maintaining maps of unit locations for food delivery purposes. It should be noted that although a General Purpose Medium Tent was used to house the distribution center, there was a large amount of excess space and a shelter the size of the Sanitation Center should be sufficient.

Dining Area, Twining Hall

Twining Hall, a large abandoned Air Force Dining Hall, was not part of the experiment but was partially restored to provide certain services in the non-tactical environment of the cantonment area which would not normally be provided by a field kitchen. Specifically, Twining Hall was utilized to:

1. Provide a dining area for the troops being fed at the XM-75 kitchen.

2. Provide a separate serving line for officers. Virtually all the food for the officers was prepared in the XM-75 kitchen and transferred to Twining Hall for serving purposes. Approximately 30 officers per meal were served from this line.

3. Provide refrigerated and dry storage space that could be secured. All dry nonperishable menu items for the two-week period were received before the start of the experiment while perishable items were received every second or third day. The food was issued to the field kitchen on a daily basis.

CHAPTER IV

WORK SAMPLING ANALYSIS

The work sampling method of work measurement can be used to develop data which can be used to make reasonably accurate decisions as to the required staffing levels for operations which are noncyclic where many different tasks are performed. In this instance the work sampling was conducted to determine the staffing levels required to operate the XM-75 consolidated field kitchen that was under test.

Work sampling consists of taking a large number of observations on individuals performing tasks in a work situation. The task being performed at each observation is recorded. The ratio of the number of observations of workers performing a specific task to the total number of observations allows one to infer the proportion of time that is actually spent on that particular activity. The larger the number of observations, the more accurate is the inference.

Observations are usually made on a random basis to obtain statistically valid results. However, in non-repetitive situations, observations can be made on a systematic basis without introducing bias, provided the interval between observations is sufficiently small. The latter approach was used in this study to maximize the sample size in any given observation period. One problem regarding work sampling was experienced early in the experiment which complicated the task of data collection. The problem concerned the tendency of a few of the cooks to utilize Twining Hall on occasion to perform work which should have been done in the experimental kitchen. Although this caused some difficulty for the personnel assigned to collect work sampling data during the first few days of the experiment, it was corrected and was not considered sufficient to affect the results or conclusions.

Job Classification

For simplicity, job classifications were limited to three categories coinciding with the position descriptions. The complete definitions for these job classifications are included in Table 1 of Appendix B. The job classifications are:

- Supervisor
- Cook
- K.P.

In addition, there were two other job categories associated with the kitchen that were not included in the actual work sampling (the NCOIC, the K.P.Supervisor). The rationale for not covering these individuals was: (a) they were required to be absent from the kitchen area a high percentage of time, and (b) these individuals were not related to the preparation and serving of food and, therefore, unaffected by savings through consolidation.

Task Definitions

Food service task definitions used in the study were based primarily on those used by the Air Force[3], adding those functions which are associated solely with field feeding. For purposes of analysis, these activities are arranged in the groups and subgroups shown in Table 2 of Appendix B.

Certain criteria were established for recording observations. For example, a worker performed a function that required his presence at a specific location, whether or not he was actually productively engaged, he was recorded as performing the task (e.g., a server on the food line was required to be there throughout the meal whether or not there was anyone to serve). Also the walking function was recorded only when an individual was observed walking with no apparent reason. For example, a person walking with hot food for the serving line was recorded as "refilling serving line."

Observation Schedule

Work sampling data was collected throughout the experiment. However, some data were excluded from the analysis. For example, the first three days were excluded since the cooks were undergoing a learning process as they were unfamiliar with operating a battalion level kitchen. The cooks were also unfamiliar with each others work habits since they were assigned to the kitchen from the various units and had to learn how to work together. This three day period was also used to test and refine the data collection procedure, to provide training for the work samplers, and to permit the food service personnel to become accustomed to their presence. In another instance, data was excluded because of a light workload, that is the kitchen was not used to prepare all three meals due to the training schedule.

Data Collection Procedure

The form used to record data is shown as Figure 1 of Appendix B. Before the beginning of each observation period, the observer recorded the date, beginning and end of the observation period, the day of the week, and the observer code. He also noted the name and position of every person working during the period at the head of the columns. The time of each observation was recorded in the left hand column (a 24-hour clock was used). The interval between observations was five minutes (or 12 observations per person per hour).

[3] USAF Management Engineering Study, "Efficiency Foods Test", MACMET, Det. 1, Maguire AFB, New Jersey, 1969

Every job position in the kitchen was assigned a one-digit code (e.g., supervisor - 1, cook - 2, K.P. - 3). Each task listed in the definitions was assigned a two digit code (e.g., prepares for cooking - 11, serves food - 21, etc.). Thus,for each observation three digits were recorded in the appropriate boxes. The first digit identified the category of worker being observed, the second and third represented what he was doing when observed. The data sheets were subsequently key punched onto cards for analysis by computer.

Results and Analysis

Figure 5, which is based on an analysis of the work sampling data, summarizes how personnel in the various worker categories allocated their time among the various work activities. The average number of productive hours expended per hour of the day for each category of worker is summarized in Table V. A brief discussion for each worker category is presented below.

Supervisors

Supervisors spent only 19% of their time supervising while thirty percent of the time was classified as cooking and serving and 47% was classified as non-productive. Since the work samplers were unable to follow individuals when they left the kitchen site, all absences from the kitchen site were classified as non-productive. Therefore, the 47% non-productive figure for supervisors is an upper limit on the true non-productive figure for supervisors; since, on occasion, the supervisors were away from the kitchen attending meetings, making telephone calls, taking cooks or K.P.'s to the field hospital, etc. - all considered necessary for job accomplishment.

Each shift had one supervisor and the only shift overlap occurred during the noon meal. Since a shift supervisor is required at all times, no cuts in the number of supervisors can be made unless a one shift operator is planned. During the experiment the supervisors averaged 7.91 productive hours per day of which 2.84 hours was dedicated to actual supervision. This suggests that the supervisor position is not a full time job and can be best filled by a working supervisor, that is, an individual who when not supervising will make maximum use of his free time by performing non-supervisory tasks.

Cooks

Forty-one percent of cook'stime was classified as non-productive. This was followed by food preparation, 31%; serving, 13%; and miscellaneous duties (filling insulated food containers, sanitation, etc.) 15%. The high percent of the cooks time classified as non-productive can be partially attributed to the shift overlap during the noon meal. Even so the rate is too high and indicates that the staffing level for cooks was too high.

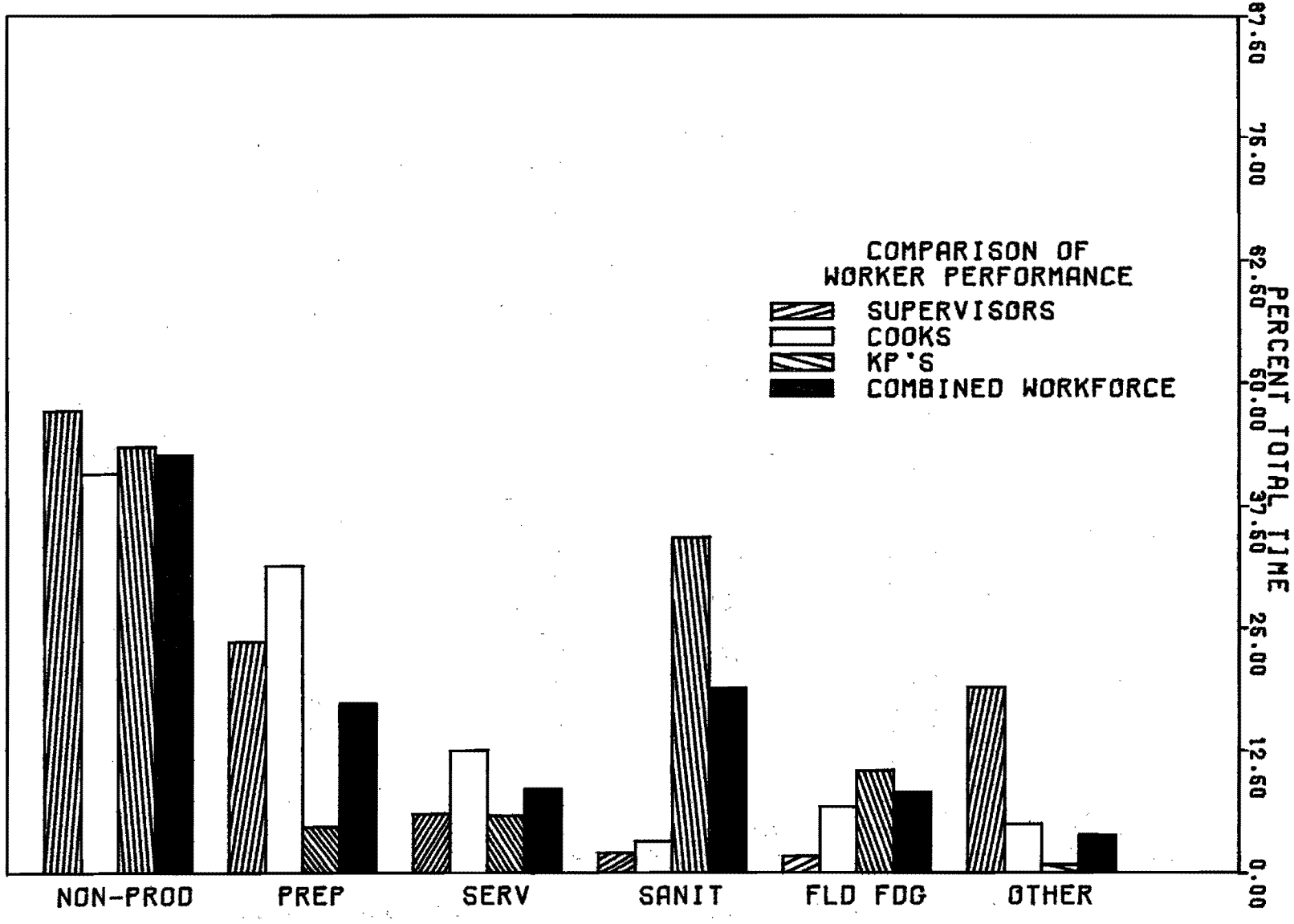


FIGURE 5. OVERALL PERSONNEL PERFORMANCE

TABLE V

AVERAGE NUMBER PRODUCTIVE HOURS EXPENDED PER HOUR OF THE DAY

Hour of Day	Supervisors	Cooks	Supervisors & Cooks	KP's*	Supervisors, Cooks & KP's
0400	0.56	2.57	3.13	1.04	4.17
0500	0.68	3.69	4.37	2.49	6.86
0600	0.65	4.08	4.73	3.89	8.62
0700	0.29	1.78	2.07	2.90	4.97
0800	0.67	3.49	4.16	4.08	8.24
0900	0.31	3.67	3.98	4.49	8.47
1000	0.42	3.88	4.30	3.30	7.60
1100	1.05	4.70	5.75	3.57	9.32
1200	0.72	5.01	5.73	2.42	8.15
1300	0.45	4.28	4.73	4.91	9.64
1400	0.38	2.87	3.25	3.58	6.83
1500	0.58	4.01	4.59	3.15	7.74
1600	0.35	4.15	4.50	3.45	7.95
1700	0.34	3.94	4.28	3.55	7.83
1800	0.33	3.23	3.56	4.94	8.50
1900	0.15	1.75	1.90	2.91	4.81
TOTAL PRODUCTIVE HOURS	7.93	57.10	65.03	54.67	119.70

* Mess kit washlines were set up and operated the first week, but they were not the second week because disposable mess gear was utilized. Therefore the number of hours dedicated to mess kit washlines during the first week has been backed out of the data. The resulting data represents the situation with disposables at all times.

By analyzing the average number of productive hours expended by cooks for each hour of the day one can effectively schedule cooks to minimize the total number of cooks required to accomplish the job. Based on the average number of productive hours expended by cooks for each hour of the day and assuming an 8-hour shift (no split shifts) ten cooks could have been effectively scheduled to provide sufficient coverage during each hour of the work day. The schedule (Table VI) would be: three cooks start at 0400, two cooks start at 0500, one cook start at 1100, and four cooks start at 1200. Since each of the ten cooks is scheduled for 8 hours, a total of 80 cook man-hours would be scheduled daily. Table V shows that the cooks at Camp Edwards averaged 57.10 productive hours per day. This implies the cooks' non-productive time would still average 22.9 hours per day or 29% of the total scheduled hours. This is an acceptable amount of non-productive time.

Because of the extended hours the kitchen operated and the large workload which must be covered during the early breakfast hours and the late dinner hours, extending the cooks workday to twelve hours per day decreases the number of cooks required (Table VII) by only one (9 instead of 10). Based on the workloads generated at Camp Edwards, the major effect of increasing the workday to 12 hours (a normal workday in the field) would be to increase the average number of non-productive cook hours per day to approximately 47% of the scheduled hours. This is due to the longer shift overlap during which the number of cooks is excessive for the actual workload.

K.P.'s

Forty-four percent of the K.P.'s time was classified as non-productive while sanitation accounted for 34% of the K.P.'s time and M-2 maintenance occupied 11% of the K.P.'s time. The high rate of non-productive time is due to the high amount of absenteeism from the work site, work avoidance, unauthorized breaks, etc.

Based on the average number of productive hours expended by K.P.'s at Camp Edwards during each hour of the workday it is possible to efficiently schedule 10 K.P.'s with eight hour shifts so that sufficient K.P. coverage would be provided during each hour of the workday. (See Table VIII).

This schedule provides 80 K.P. man hours per day. Based on the Camp Edwards data the K.P.'s averaged 54.7 productive hours per day. Therefore, with the designed schedule the K.P.'s non-productive time would average 25.3 man hours or 31.7% of the total scheduled hours. This amount of non-productive time is sufficiently high to permit breaks and to allow the K.P.'s to take care of any personal needs.

Because of the number of hours the kitchen operated, 16 hours per day, and large K.P. workload during the breakfast hours and the dinner hours, extending the K.P.'s workday from eight hours to twelve hours only decreases the number of K.P.'s required from ten to nine, (Table IX) a net savings of one. The major effect of increasing the workload to 12

TABLE VI

Proposed Cook Schedule
(8 Hr. Workday)

HR OF DAY	SHIFT A	B	C	D	TOTAL ASSIGNED	REQUIRED (MINIMUM)
04	3				3	3
05	3	2			5	4
06	3	2			5	5
07	3	2			5	2
08	3	2			5	4
09	3	2			5	4
10	3	2			5	4
11	3	2	1		6	5
12		2	1	4	7	6
13			1	4	5	5
14			1	4	5	3
15			1	4	5	5
16			1	4	5	5
17			1	4	5	4
18			1	4	5	4
19				4	4	2

TABLE VII

Proposed Cook Schedule
(12 Hr. Workday)

HR OF DAY	SHIFT A	SHIFT B	SHIFT C	TOTAL ASSIGNED	REQUIRED (MINIMUM)
04	3			3	3
05	3	2		5	4
06	3	2		5	5
07	3	2		5	2
08	3	2	4	9	4
09	3	2	4	9	4
10	3	2	4	9	4
11	3	2	4	9	5
12	3	2	4	9	6
13	3	2	4	9	5
14	3	2	4	9	3
15	3	2	4	9	5
16		2	4	6	5
17			4	4	4
18			4	4	4
19			4	4	2

TABLE VIII

K.P. Schedule*
(8 Hour Workday)

HR OF DAY	SHIFT A	B	C	D	TOTAL ASSIGNED	REQUIRED (MINIMUM)
04	2				2	2
05	2	2			4	3
06	2	2	1		5	4
07	2	2	1		5	3
08	2	2	1		5	5
09	2	2	1		5	5
10	2	2	1		5	4
11	2	2	1		5	4
12		2	1	5	8	3
13			1	5	6	5
14				5	5	4
15				5	5	4
16				5	5	4
17				5	5	4
18				5	5	5
19				5	5	3

* A simpler (but not as effective) schedule which would also provide sufficient coverage throughout the day would be to start five K.P.'s at 0400 and to start five K.P.'s at 1200.

TABLE IX

K.P. Schedule*
(12 Hour Shifts)

HR OF DAY	SHIFT A	B	C	D	TOTAL ASSIGNED	REQUIRED (MINIMUM)
04	2				2	2
05	2	2			4	3
06	2	2			4	4
07	2	2	1		5	3
08	2	2	1	4	9	5
09	2	2	1	4	9	5
10	2	2	1	4	9	4
11	2	2	1	4	9	4
12	2	2	1	4	9	3
13	2	2	1	4	9	5
14	2	2	1	4	9	4
15	2	2	1	4	9	4
16		2	1	4	7	4
17			1	4	5	4
18			1	4	5	5
19				4	4	3

* A simple but less effective schedule would be to start 4 K.P.'s at 0400 and 5 K.P.'s at 0800.

hours would be to increase the average number of non-productive K. P. hours to 49% of the scheduled K.P. hours. This is mainly due to the extended period during the middle of the day during which all the shifts overlap creating an excessive number of K.P.'s to be on duty.

Total Workforce (Supervisors, Cooks, and K.P.'s)

Forty three percent of the total workforce's time was rated as non-productive (of which approximately 10% was considered as designated rest breaks). It is interesting to note that the total workforce allocated a larger portion of their time to sanitation than they did to food preparation (19% to 17%). Nine percent of the workforce's time was dedicated to serving while eight percent was dedicated to M-2 burner and immersion heater maintenance. The amount of time dedicated to serving is low due to the high percentage of meals served away from the kitchen location.

Table X shows the average daily manpower requirements for the different work functions that exist in the consolidated kitchen. (Of importance in this table is the fact that the average level of work expended in food preparation and sanitation are comparable 36.4 man-hours of labor in the preparation of the food and 39.5 man-hours for sanitation purposes).

TABLE X

AVERAGE DAILY MANPOWER REQUIREMENTS

WORK FUNCTION	PRODUCTIVE MAN HOURS REQUIRED
Food Preparation	36.4
Serving	18.2
Sanitation	39.5
Field Feeding	17.4
Other	8.2
Total	119.7

Productivity

Productivity in food service operations is frequently defined as the number of meals prepared per man-hour of labor expended. This same measure is used in this study. Table XI shows the productivity in meals per man-hour for the six full days during the experiment in which data were collected.

TABLE XI

PRODUCTIVITY BY DAY

Day	8-12	8-13	8-14	8-18	8-19	8-20	Average
Man-hours*	223	241	245	232	227	237	234
Number of meals served	2151	1814	1502	1681	2010	2095	1876
Avg. Meals/ man-hour	9.6	7.5	6.1	7.3	8.8	8.8	8.0

*The NCOIC and K.P. Supervisor are included.

Inasmuch as the man-hours remain relatively constant throughout the six days, the high degree of fluctuation on productivity can be primarily attributed to the variability in the daily number of meals served (i.e., on 14 August the manpower and facilities were available to prepare in excess of 2,000 meals although only 1502 were required, thereby reducing productivity).

The average productivity of 8.0 meals per man-hour achieved by the consolidated kitchen, when compared to 3.9 meals per man-hour[4] in the present company-size field kitchen represents over 100% increase in productivity. This increase in productivity was achieved in spite of the 43% level on non-productivity recorded during the experiment.

Conclusion

Forty three percent of the total workforce's time was classified as non-productive. This indicates the staffing levels employed during the experiment were too high. Based on an analysis of the average number of productive hours expended by each worker category during each hour of the day and assuming an eight-hour shift for all workers; two supervisors, ten cooks, and ten K.P.'s, if appropriately scheduled, would have been sufficient to handle the average daily workload generated by the battalion level kitchen as operated at Camp Edwards.

If a twelve-hour shift is assumed for all worker categories, two supervisors, nine cooks, and nine K.P.'s would be required. The twenty-two personnel on the eight-hour shifts would be scheduled for 176 man-hours per day while the personnel on twelve-hour shifts would be scheduled for 240 man-hours per day. Based on the Camp Edward's data the kitchen staff averaged 119.70 productive man-hours per day. This implies that the twenty-two personnel on the eight-hour shift would have averaged 56.30 (176.00 - 119.70) non-productive hours per day while the twenty individuals on the twelve-hour shifts would have averaged 120.7 (240-

[4]op. cit. 1

119.3) non-productive hours per day. The non-productive time would average 32% of the scheduled hours for the eight-hour shifts and 50% of the scheduled hours for the twelve hour shifts. The non-productive figure of 32% for the eight hour shifts is sufficiently high to cover breaks and to permit the workers to take care of any personal needs. In effect, increasing the length of the work shift by 50% produces only a 10% reduction in staffing requirements.

Because of the data collection procedure and the nature of the job assignments in the experimental system, several individuals (and thus some tasks) were not covered by work sampling.

Thus, it has been estimated that five additional individuals, to include an NCOIC supervisor and four cooks (for K.P. supervision, supply, and off-site feeding), are required to perform these uncovered tasks.

CHAPTER V

STAFFING REQUIREMENTS

The design staffing levels for the experiment were based on the number of customers to be served and previous data analysis of consolidated garrison and field feeding operations where three hot meals were served daily. These data consisted of:

1. Work Sampling data from Army and Marine Corps field exercises.

2. Analysis of Army and Marine Corps staffing guides and Tables of Organization (T.O.'s).

3. Tests of developmental field kitchens.

4. Information from consultant and institutional sources.

A breakdown of the design personnel staffing for feeding the 864 troops supported during the experiment is shown in Table XII. Two important points should be noted here: first, in developing the original staffing level, the length of workday was assumed to be twelve hours; and second, three work tours were planned with some personnel reporting for duty at 0400, others at 0600, and the remainder at 0800. Also, the number of K.P.'s was established at two levels, depending upon whether mess kits or disposable trays were used by consumers. This was due to the fact that the mess kit requires maintenance of wash lines which represents a significant sanitation workload. When disposables are used by consumers, the wash lines are unnecessary and K.P. requirements are reduced.

TABLE XII

XM-75 CONSOLIDATED KITCHEN DESIGN STAFFING LEVEL

Job Category	Grade	No. of Personnel
NCOIC	E-8	1
First Cook	E-7/E-6	2
Cook	E-5/E-4	6
Apprentice Cook	E-3	3
Kitchen Police*	E-2	12
TOTAL		24

*The number of kitchen police shown is based on use of mess kits; this number is reduced to 9 when disposables are used.

Length of Workday

The experiment began using the staffing levels shown in Table XII. However, due to the hours of operation and workload (the kitchen operated from 0400 to 2000) producing three meals per day, the planned one shift 12-hour workday had to be extended to nearly 15 hours for some of the cooks. After the first three days of operation the cooks were becoming fatigued and morale was beginning to deteriorate and it became necessary to revert to a two-shift operation. This allowed the workday to be greatly reduced (9-1/2 hours including two 30-minute breaks for meals).

It cannot be emphasized too strongly that the duties of a cook working under field conditions (without many of the powered items of equipment normally available in garrison) are labor intensive. This, combined with the heat build-up due to the M-2 burners*, the high ambient conditions which prevail during the summer months, plus the combination of fumes given off by the M-2 burners make the cooks working environment extremely severe. It is, therefore, considered unrealistic to expect that even individuals who are in excellent physical condition and are highly motivated could perform satisfactorily under these conditions for longer than 12 hours per day over extended periods of time.

In view of the above, i.e., the change to a two-shift operation, plus the need to have a dedicated supervisor for the K.P.'s, the staffing levels for food personnel were increased from 12 to 21. A breakdown of the revised staffing requirements is presented in Table XIII.

*Each burner has a maximum output of 64,000 BTU per hour and at times up to 20 of these burners were operated simultaneously within the kitchen shelter.

TABLE XIII

XM-75 CONSOLIDATED KITCHEN ACTUAL STAFFING LEVELS

Job Category	Grade	No. of Personnel
NCOIC	E-8	1
Kitchen Supervisor	E-7	2
First Cook	E-6	3
Cooks	E-5/E-4	4
Apprentice Cook	E-3	4
Supplyman	E-5	1
K.P. Supervisor	E-5	2
Burner Maintenance	E-4	2
Bakers	E-5	1
Hot and Cold Drinks	E-4	1
Kitchen Police*	E-2	12
TOTAL		33

*KP staffing was reduced to 9 when disposables were used in place of mess kits.

Personnel Savings

The revised staffing level of 33 was 9 more than originally intended but still represented a savings of 19 people over the 52 personnel that would be required with company level kitchens. Analysis of the work sampling data collected during the experiment shows that our estimate of 33 was too high and that a maximum of 25 personnel, or one above the original estimate, were needed to operate the XM-75 system.

Table XIV presents a comparison of the staffing levels for a battalion operating conventional company level kitchens, the Camp Edwards staffing, and the calculated staffing level (based on work sampling data, Table V) that would have sufficed at Camp Edwards.

TABLE XIV

COMPARISON OF ARMY BATTALION FOOD SERVICE
STAFFING REQUIREMENTS

Job Category	Company	XM-75 Camp Edwards I	XM-75 Calculated
NCOIC	-	1	1
Supervisors	5	4	4
Cooks	24	16	11
Kitchen Police	23	12	9
	52	33	25
Savings			
Cooks	-	8	13
Kitchen Police	-	11	14

K.P. Personnel

Current Army policy is to staff field kitchens with sufficient numbers of trained personnel to perform all of the food preparation and cooking functions. However, the major portion of the sanitation workload and some of the serving has to be performed by personnel who augment the staff of food service personnel. These augmentation personnel are commonly referred to as K.P.'s and generally they consist of junior grade enlisted personnel since this function is performed on a duty roster basis.

With the consolidated battalion level kitchen, all of the K.P. personnel no longer come from one company but now they are provided by as many as five different companies because several companies are being serviced by one kitchen and the K.P. chore is spread proportionately among the various units. The Camp Edwards experiment pointed out very emphatically some major problems which will be experienced if the Army's existing K.P. policy is not changed. These problems relate to the unreliability of K.P.'s. At no time during the experiment were all of the K.P. personnel, who were assigned, on duty. Secondly, every day through the entire experiment a significant number of K.P.'s reported for duty anywhere from one to three hours late. Third, problems were consistently experienced with K.P.'s being absent without authorization. Fourth, there was clearly a lack of motivation on the part of the K.P.'s and this reflected in the lower efficiency experienced in their work activities.

The problems experienced during the Camp Edwards experiment are not considered to be unique to the National Guard personnel or battalion kitchens but rather the ingenuity of the typical American soldier who avoids and minimizes the amount of effort expended on work he considers menial or degrading. Therefore, this problem can be expected to persist in regular Army units, also similar problems have been observed throughout this study in visits to field training exercises.

The Army has two options to deal with this problem. The first is to change the policy on K.P.'s whereby K.P.'s would not be assigned a daily duty roster but rather a weekly duty roster. Therefore, they would be assigned to the kitchen for seven continuous days and would be billeted in the kitchen area. This would minimize the problem of K.P.'s reporting for duty late and also in the requirement to retrain K.P.'s on a daily basis. The second option is the outright elimination and replacement of K.P.'s with junior cooks. The major advantage with elimination of K.P. concerns the increase in combat effectiveness which would be achieved by returning all of the K.P. personnel to their mission functions. A secondary advantage would be the increased efficiency that could be expected with trained food service personnel performing these functions and, therefore, a lesser number of personnel would be required to perform these functions. Obviously, the disadvantage of elimination of K.P.'s is that some of the savings of cooks achieved through consolidation would have to be reinvested, thus reducing the total number of personnel with a food service MOS who could be eliminated.

Conclusion

The XM-75 consolidated field feeding system, if adopted by the Army, would yield a significant reduction in the number of cooks and K.P.'s required. Compared to the staffing requirements for company level kitchens the battalion level kitchen as staffed at Camp Edwards yielded a 28% reduction in the number of cooks and a 48% reduction in the number of K.P.'s or a total staff reduction of 37%. However, the staffing utilized at Camp Edwards was too high. If the staffing level developed based on the analysis of the work sampling data were employed, the manpower savings would have increased to at least 45% for cooks and 61% for K.P.'s yielding a total staff reduction of 52%.

CHAPTER VI

FOOD ANALYSIS

A new 14-day menu (see Appendix C) was developed especially for the experiment using DOD Food Preference data[5] to modify the 14-day menu used by the National Guard during their 1974 annual training. This new menu was designed to:

1. Offer more highly preferred foods.

2. Select foods that do not require excessive preparation labor.

3. Utilize foods which are compatible with the field kitchen equipment provided.

4. Select foods that maintain quality when transported in insulated food containers for serving in remote areas.

In general, the concept of a field menu is to offer consumers little or no choice of meal components. Therefore, the most popular foods should appear on the menu. The National Guard menu that was modified contained foods such as grapefruit juice, apricots, lima beans, spinach, and kadota figs which are consistently rated low in consumer acceptance. Therefore, these foods were deleted. High labor foods such as swedish meatballs, salisbury steak, and fresh potato items were also deleted. Food difficult to precook and hold or transport in insulated food containers such as griddle cakes, were also replaced. There were only a few changes for this latter reason since the National Guard menu had been designed with this in mind.

Cost

The new menu was analyzed for cost and nutrition using computer programs designed for that purpose. Costs are based upon Defense Personnel Support Center (DPSC) price information for August 1975 and allow comparison with the August 1975 Basic Daily Food Allowance (BDFA) obtained from Fort Devens, Massachusetts (nearest large Army post). The high, low, and average costs for the 14-day cycle are shown in Table XV.

[5]Meiselman, H.L., et al., "Armed Forces Food Preferences," Technical Report TR 75-63-FSL, US Army Natick Development Center, December 1974.

TABLE XV

RANGE OF MEAL COSTS

	Breakfast	Lunch	Dinner	Daily Total
Low	$0.51	$0.61	$0.67	$2.12
High	0.65	2.51	2.59	3.90
Average	0.58	1.00	1.11	2.70

Average daily ration cost compares favorably with the Fort Devens BDFA of $2.73. These costs are presented for comparison to the BDFA and do not represent the cost to the National Guard since Camp Edwards operates a non-appropriated fund commissary whose prices are somewhat higher than DPSC's. Figure 1 in Appendix C presents the detailed meal and daily cost data.

The range of meal costs for the dinner and supper meals is large ($0.61 - $2.59) due to a high cost entree (beef steak). Removing the two steak meals would change the range to $0.61 - $1.36. This is not excessive when considering that it encompasses meals with low cost but nutritious and popular entrees such as ground beef and macaroni, and meals with more expensive entrees such as roast beef and pork chops.

Nutrition

Figures 2 through 5 in Appendix C present a nutritional analysis of the menu. The nutrients shown are those for which the military prescribes a Daily Dietary Allowance [6] (DDA). Nutritional values were calculated for each food item using the Armed Forces recipe service formulations for 100 servings and USDA Handbook No. 8[7] nutrient contents, except for cooked meats where an Armed Forces Handbook[8] was used for nutrient contents. The nutritional values were then summed over all food items comprising each meal. The average nutrient values for the menu, DDA for male personnel, and the average nutrient value expressed as a percent of this DDA have been extracted from Figure 5 of Appendix C and summarized in Table XVI below:

---

[6]AR 40-25, "Medical Services Nutritional Standard, " Dept of the Army, 10 Aug 1972

[7]Composition of Foods," United States Dept of Agriculture, Handbook No. 8, Dec 1963

[8]DSAH 1338.1, "Composition of Foods Used by the Armed Forces," Defense Supply Agency, May 1974.

TABLE XVI

AVERAGE NUTRIENT VALUE OF CAMP EDWARDS MENU

Nutrient (Units)	Average Value	Military DDA	% of DDA
Calories (Cal)	4,744	3,400	140
Protein (g)	230	100	230
Fat (g)	158	Max.*	75
Calcium (mg)	1,874	800	234
Iron (mg)	26	14	185
Vit. A. (IU)	14,604	5,000	292
Thiamine (mg)	4.0	1.7	236
Riboflavin (mg)	3.4	2.0	168
Niacin (mg)	29	22	132
Ascorbic Acid (mg)	197	60	329

*Calories from fat should be less than 40% of the menu calories. Using 9 calories per gram of fat, this menu should contain less than 211 grams of fat.

On a daily basis, the menu is nutritionally adequate, usually by a wide margin. Even fat, excess dietary amounts of which have caused some controversy in the last few years, is well under its maximum.

Figure 2 through 5 in Appendix C show the values for breakfasts, lunches, dinners, and totals for the day. For analysis on a per meal basis, it was assumed that each meal should provide one-third of the DDA. This is approximate at best since all three meals are not equal. Only niacin in breakfasts could be considered borderline. However, if niacin equivalents from tryptophan are considered, this potential shortfall is eliminated. According to USDA Handbook No. 8, tryptophan from eggs can contribute 1.6 mg of niacin equivalents per day and eggs are a major component of military breakfasts.

It must be emphasized that the nutritional values presented are computer estimates of average nutrition available, not nutrients consumed. Calculations assume standard portion sizes and some of each menu item. For example, if 20% cocoa, 30% tea, and 50% coffee were programmed in the menu, the computer calculates nutrients for each individual based

upon 0.2 servings of cocoa plus 0.3 servings of tea plus 0.5 servings of coffee. Also, there is no allowance for nutrient losses resulting from heating vegetables, cooking pastries, holding the food hot on the serving line, or while transporting the hot food in insulated food containers. However, daily thiamine is 236% of DDA and daily ascorbic acid is 329% of DDA providing considerable excess of the most heat liable nutrients.

Initial Operations

The food ingredients needed for the 14-day menu were ordered from the Camp Edwards Commissary about one month before the start of the experiment. Since a new menu was being used, the quantities of each of the food ingredients per 100 servings were calculated using computer recapitulation programs designed for that purpose. The number of servings of each menu item needed for the approximately 900 troops expected during the experiment was estimated at the time of ordering.

The commissary required all non-perishables for the entire 14-day period to be picked up at one time at the start of the experiment. Perishables were delivered two or three times per week by commercial vendors. To simulate field kitchen operations, which generally involve a daily pick-up at the designated ration breakdown point, Twining Hall was employed as the ration breakdown point. Each day, the ingredients for the meals to be served the following day were issued; perishables and items to be prechilled (e.g., canned fruit) to the field refrigerator and non-perishables (including bread and pastries) to the XM-75 kitchen.

Food Preparation

Armed Forces recipes were supplied, but as often observed in food service operations, the cooks seldom referred to the recipes. Nevertheless, it was possible to exercise some control of formulations by issuing the ingredients to the kitchen daily and by not supplying bulk spices unless called for by a recipe.

Possibly some of the reluctance to use recipes resulted from the recipes being designed for garrison kitchens rather than field kitchens. Recipes are needed that minimize ingredients and specify procedures based upon the field equipment available for preparation. It was interesting to note that considerable confusion occurred on the part of the cooks when it came to filling the insulated food containers for feeding away from the kitchen site. Due to lack of information of container capacity, the cooks did not know how many servings of a particular food item could be packed into an insulated food container. As a result, more food was distributed to the field than was necessary. This problem could be solved and use of recipes would be encouraged if this information was added to the Armed Forces Recipes.

Although meals were usually served on time, many of the poor practices common to military operations were encountered; i.e.,

not following recipes, and preparing food too far in advance of serving. Some of these practices were directly related to the training problems mentioned earlier. The cooks overeacted to several incidences of almost being late with a meal which occurred during the first three days and almost running out of prepared food. In addition, the food needed for feeding at the remote areas had to be ready approximately one hour before meal time to allow sufficient time to place the food in insulated containers and transport it to the remote sites.

Quality Control

Food technologists from Natick Research and Development Command (NARADCOM) sampled most of the food as it was being prepared to monitor quality. This was necessary since it was observed that most of the cooks prepared the food without tasting during preparation. In addition, the food technologist rated entire meals for technical quality of each food, measuredthe food temperatures and weighed to portions. Table 6 in Appendix C presents their data. Most of the technical ratings of food quality were above the neutral point of 5.0 on the 9-point Hedonic scale. The exceptions for entrees are detailed below:

1. Spaghetti and meat sauce was rated 4 because the spaghetti was badly overcooked and the meat was sparse and rubbery.

2. Fried chicken was rated 4 (second week) because the chicken was past the point of optimum quality.

3. Beef stew was rated 5 because the meat chunks were much too large. Entrees influence the overall meal rating more than any other menu group and the meals which included these entrees received the lowest ratings from the consumer survey (Chapter VII.)

Technical observations indicated that chicken presents a serious problem when used on a field menu. Specifically, when deep fat fried, the chicken resembled boiled chicken since it was difficult to get the fat hot enough with the field range. Also, when ovens were used for roasting the chicken, some of it was cooked so far ahead (as much as four hours) as to present a potential for food poisoning.

From a quality standpoint, the bakery items rated poorest as a menu group. Some of the problem was caused by the bakery mixes since they were not federal stock items but whatever the commissary happened to procure on the commercial market. Also, equipment problems exist with the M-59 range cabinet in that oven temperature cannot be readily controlled and it is difficult to keep the cabinets level on uneven ground. Baked items varied from burned to soggy and from 1/4"thick to 2 inches thick, all in the same batch. Baking was performed at night in both the XM-75 kitchen tent and in Twining Hall. Achieving satisfactory baked items in field operations appears to be a continuing problem.

One final quality consideration is the portion size. As evidenced by Table XVII portion control throughout the experiment left much to be desired. For example, entrees weights ranged from a low of 2.6 ounces to a high of 7.2 ounces when the normal portion weight should have been in the 4.0 to 6.0 ounces range. It should be noted that the data shown in Table XVII are the results of a food technologist passing through the serving line and receiving "one portion" of each item on the menu.

TABLE XVII

FOOD ITEM WEIGHT VARIATION (OUNCES)

Menu Group	Low Weight	High Weight	Normal Portion Weight
Entrees	2.6	7.2	4.0 to 6.0
Casseroles	7.0	14.4	10.0
Potatoes	2.0	10.7	4.0 to 6.0
Vegetables	1.2	7.0	3.0
Salads	2.8	4.6	2.0 to 4.0
Desserts	1.5	9.2	3.0 to 6.0

In an effort to obtain additional data on portion size, consumers were selected at random as they left the serving line and their whole tray weighed. Beverages were not included in these weights. The data are presented in Table XVIII below:

TABLE XVIII

CONSUMER TRAY WEIGHTS* (OUNCES)

Meal	No. Samples	Average	Range	Normal Meal Weight
Breakfast	25	6.2	4.4 to 9.9	6 to 8
Dinner	99	19.4	3.1 to 32.2	16 to 25**
Supper	50	20.3	8.9 to 35.5	16 to 25**
Supper (Field)	8	23.7	21.0 to 26.0	16 to 25**

*Excluding weight of tray itself.
**Depending upon whether an entree or casserole.

These data indicate that, in general, sufficient quantities of food were provided to consumers although some of them obviously were extremely fussy eaters. Specifically, the only manner in which a consumer could receive 3.1 ounces of food at a dinner meal would be for him to refuse most of the items offered. Another measure of food quantity which can be employed here is raw food ingredient weight. The computer program used to calculate cost and nutrition shows that 26 ounces of food (including formulation water) were provided for the average meal.

CHAPTER VII

CONSUMER ACCEPTANCE

Since the success of Army consolidated field feeding systems is to a large part dependent upon the ability of the system to continue to provide high quality, nutritious hot meals to the consumer, a concerted effort was made during the experiment to obtain consumer acceptance data. These data were obtained through interviews and questionnaires administered by behavioral scientists from the Natick Research and Development Command. A sample food rating survey is included at the end of Appendix D.

Meal Acceptance

Respondents were asked to rate the overall meals ("the combination of foods") on a nine point hedonic scale. The meal ratings, shown in Table XIX, indicate that there are no systematic effects due to whether the meal was breakfast, lunch, or dinner. The majority of the overall meal ratings (18 of 20) were above the neutral rating of 5 indicating some degree of like for the menus. Breakfast meals scored between 6.44 and 6.93, indicating good acceptance of the meals as a whole (but not necessarily of each item). Dinner meals scored from 5.74 to 6.83. However, lunches ranged from 4.21 to 6.59 and included two meals which received low scores from troops surveyed in the remote areas. One was a beef stew meal served on 14 August (4.21) and the other was a barbequed beef cube meal on 19 August (4.70). Both of these meals included entrees which were severly downrated in acceptance suggesting that the meal rating is not independent of entree acceptability. These data are consistent with previous research[9] concerning the prepotent role of the entree in menu evaluation. It should be emphasized, however, that field feeding introduces constraints which do not exist in the garrison system and, therefore, greatly reduces the options available to the menu planner.

Food Acceptance

The food acceptance ratings for onsite and remote areas are also presented in Table XIX. Detail meal and menu item rating for on-site and remote areas are presented in Tables 1 & 2 of Appendix D. The acceptance ratings collected from on-site consumers contained only two ratings below the neutral point of 5. Clearly, there was generally acceptable food served at the kitchen site.

---

[9] Rogozenski, J.E., et al, "A System for the Preference Evaluation of Cyclic Menus", Technical Report 75-46-OR/SA, October 1974.

TABLE XIX

MEAN FOOD ACCEPTANCE RATINGS

Date	BREAKFAST		LUNCH		DINNER	
	On-Site	Remote	On-Site	Remote	On-Site	Remote
12 Aug	-	-	-	5.11	5.90	-
13 Aug	-	-	6.11	-	-	5.74
14 Aug	6.46	-	-	4.21	6.83	-
15 Aug	-	-	6.57	-	-	-
18 Aug	-	-	5.82	5.59	6.00	-
19 Aug	-	-	6.31	4.70	-	6.83
20 Aug	-	-	5.08	6.50	-	6.56
21 Aug	6.44	6.93	6.00	-	-	-

The acceptance ratings from remote area consumers are more variable, and include more low rated items. There were three main dishes, one salad and four starches which rated below 5.0. The fact that the items which generally needed little preparation, e.g., bread and beverage, never scored low suggest that preparation or temperature may be involved in the low ratings. The reason for low ratings in remote areas is unclear; possibilities would be deterioration over time, failure to preheat the insulated containers, deterioration from handling, deterioration from the method of serving in the field, from reduced temperature, or simply from the fact that problems at the kitchen site were more easily remedied than problems in the remote areas.

Serving Temperature

The serving temperature was rated on a 5-point scale; foods which were just right in temperature should have been rated 3, while foods which were too warm received lower ratings (either 1 or 2) and foods which were too cold received higher ratings (either 4 or 5). Ratings from onsite consumers (Appendix D, Table 3) showed that main dishes starches, and vegetables all scored slightly above 3, suggesting that they were not warm enough on the average. Bread was just right at 3.08, as expected, while ratings for salads and beverages indicated that these items were not cold enough. Ratings from remote areas (Appendix D, Table 4) indicated more variable results, as would be expected. All salad and beverage ratings were below 3 indicating too warm a serving temperature. Overall, the problem of serving temperature was more numerous in remote areas than onsite, as would be expected. More attention must be paid to the food containerization operation in order to improve acceptability.

Quality Comparison to Previous Years

The final question of the food rating survey asked respondents, "How did this food compare with other food you have been served in the field in previous years" (which was prepared and served at the company level)? This survey was included since the duration of the experiment made it impossible to have a control kitchen. A five point scale (from much better to much worse) was also used in this survey. A total of 230 responses were obtained at 11 meals from onsite (Twining Hall) consumers, and 137 at nine meals from consumers in remote areas.

The average for all onsite surveys was 3.55 and for all remote meals 3.39. No meal surveyed at the kitchen site yielded an overall rating of less than 3, i.e., on the negative side of the scale. Three meals out of 8 surveyed in remote areas did yield overall ratings of less than 3 (lunches on 12, 14, and 19 August). Therefore, one can conclude that the food provided by the consolidated kitchen was at least of comparable quality when compared to the food served by the company kitchens normally used by consumers.

In order to directly compare the onsite and remote areas, four meals were surveyed in both locations. The four sets of matched weighted means are shown in Table XX. While data are not sufficient to permit statistical evaluation, there is clearly no evidence of a higher rating for the kitchen site. In fact, for three out of four meals, the rating from the remote area is higher.

TABLE XX

COMPARISON OF FOOD QUALITY TO PREVIOUS YEARS

Date	Meal	Onsite	Remote
8/18	Lunch	3.67	4.30
8/19	Lunch	3.36	2.69
8/20	Lunch	3.50	4.36
8/21	Breakfast	3.50	3.80

Note: Raters used a 5 point scale from much better (5) to much worse (1). Ratings above 3 indicated better food.

Food Quantity

An interview consisting of five questions which required yes or no answers was used to assess customer attitudes toward the quantity of food they were receiving; i.e., whether they could and did go back for seconds and whether they ate more in the field. The data were analyzed separately for those interviews conducted onsite (Twining Hall) and those at remote areas and the results are presented in Appendix D, Table 5.

In agreement with past studies, [10,11] up to 25% of respondents indicated that they did not receive enough to eat on the day before the interview. The question was asked with reference to a specific day to avoid confusion in a situation where quantity could conceivably be adequate on one day and not on another. Responses in the two areas did not differ significantly.

When asked, "Do you eat more in the field," 34% and 45% said "yes" in remote and onsite areas, respectively. The difference between onsite and remote was not significant at the 0.05 level of significance. It was apparent from many comments that "field" was interpreted by respondents to mean remote areas in general, and for most people, did not include a situation such as that represented by Twining Hall. Therefore, the figure of 45% "yes" collected in remote areas probably is more indicative.

Conclusions

As a result of the foregoing analysis, the following can be concluded:

1. Food served to the consumers during the experiment was generally acceptable and at least of comparable quality when compared to food served by the company kitchens used by consumers in previous field exercises.

2. Ratings of serving temperature of food indicates that a problem exists with a number of food items regarding serving temperature. Additional effort is needed to develop an adequate system of food containerization to maintain proper temperature.

3. Additional menu development and recipe formulation are needed to further improve food acceptability in field feeding.

[10]Harmon, R.C., "Development Test II (Service Phase) of Meal, Ready-to-Eat, Individual, Final Report," May, 1974

[11]Hiltz, S.A., "Development Test II (Service Phase) of Meal, Ready-to-Eat, Individual, Final Report," June 1974

CHAPTER VIII

Microbiological Analysis

The general objective of the microbiological analysis was to determine the ability of the food service system to maintain acceptable standards of cleanliness, sanitation and food handling. Procedures and data supporting this analysis are in Appendix E.

The specific responsibilities assigned to the microbiology group were to:

- Conduct microbiological analysis on food samples considered to be of high risk and on the potable water supply.

- Evaluate kitchen facilities daily for cleanliness.

- Monitor temperature profiles of cooked and chilled items as prepared and as served.

- Evaluate mess kits, canteen cups, and eating utensils for cleanliness.

Microbiology

All food systems monitored during the experiment were evaluated for their actual performance as regards to public health and the potential of the system for food poisoning or infectious disease outbreak.

No food poisoning outbreak occurred during the study. Inspection of the data indicates that the microbiological counts for all of the cooked items were generally satisfactory. The raw salads had high microbiological counts; however, this is characteristic of these products.

The likelihood of the field feeding system at Camp Edwards causing a food poisoning outbreak was low due to long exposure to a high cooking temperature and consumption of the food within short periods of time. A potential health hazard existed since improper serving temperatures were frequently encountered, the food preparation and serving surfaces were often in an unsatisfactory sanitary state and poor personnel practices in food handling were observed.

Temperature

Serving temperature was difficult to control, particularly at the remote sites. Fifty percent of the entree items were below 140°F and over 90% of salads and dressings were served above 55°F. In general, it can be stated the hot foods were not hot enough and the cold foods were not cold enough, presenting good (sometimes optimum) conditions for microbial growth.

Water

A problem arose in the quality of the water found in the unit water trailer used at the XM-75 kitchen, and also in a trailer and a lyster bag in the field. When tested with a total count water tester and a coliform water tester, the three were found to contain high total counts (over 1000/ml) but not coliform organisms. Visual examination of the trailers indicated that they had not been properly sanitized and a remedial program was instituted.

Food Service Equipment

RODAC plate and swab counts were utilized to evaluate the cleanliness of food service equipment and surfaces. Two problem areas were found: (a) the insulated food containers and their inserts; and (b) the meat slicer and the utensils; such as dippers, spoons, etc., were not well sanitized and dried.

Mess Kits

The evaluation of mess kit and canteen cup sanitation was conducted over a very short period of time. The mess kits themselves were generally of acceptable cleanliness but at least half of the canteen cups were not. Many soldiers did not use their cups and the cups were rarely washed. It was noted that when assembled, the outside of the canteen often transferred soil to the inner surface of the cup.

Sanitation

The vast majority of the difficulties encountered with sanitation (see Appendix E) can be minimized or even almost completely eliminated if a number of direct actions are taken. These include:

- Having a thoroughly trained and responsive KP supervisor or KP's on a more permanent basis so they can be trained in kitchen sanitation.

- Policing the areas around the kitchen and pot washing center, and preventing grease and food waste from accumulating. If accumulation does occur then the buildup areas should be disinfected.

- Cleaning all surfaces in the main kitchen by thoroughly washing the surface, rinsing the soap off and sanitizing with a 30-100 ppm chlorine solution or its equivalent. Neither sponge nor soiled rags should be used for the final rinse and disinfection.

- Redesigning the sinks in the pot washing center for easier insertion and removal of items.

- Providing an adequate drainage and disposal system for the pot washing center.

CHAPTER IX

CONSUMER MESS GEAR ANALYSIS

The consumer mess gear survey asked respondents to indicate whether each of several types of mess gear was acceptable or unacceptable for the attribute listed (e.g., sanitation, easy to clean, etc.). A sample of the form used is included at the end of Appendix F. Respondents rated all the attributes for each piece of mess gear included in the survey, not just the one(s) they were using.

The mess gear actually used in this exercise was the standard metal mess kit with its utensils, a disposable tray with plastic utensils, and metal canteen and paper cups. In addition, the survey included non-disposable trays, paper plates, and dining facility utensils (knife, fork, and spoon). Results were analyzed separately for personnel surveyed at the kitchen site (Twining Hall) and in remote areas. Since there was no difference in the patterns of response, the results are presented as a composite in Table 1 of Appendix F. Table XXI summarizes the overall rating question for both the standard mess kit and the new disposable system. Clearly, the disposable system was preferred overwhelmingly by the consumers when compared to the mess kit.

TABLE XXI

OVERALL CONSUMER RATINGS OF MESSGEAR

	Acceptable	Uncertain	Unacceptable
TRAY OR PLATE			
Metal Mess Kit	4%	0%	96%
Disposable Tray	94%	1%	5%
UTENSILS			
Messkit Utensils	13%	10%	77%
Plastic Utensils	85%	4%	11%
DRINKING CUPS			
Canteen Cups	24%	9%	67%
Paper Cups	88%	6%	6%

Sample Size 79

The standard items (mess kit, mess kit utensils, and metal canteen cup) each scored lowest in overall acceptability. In addition, the standard mess kit scored lowest on four out of the six attributes, when compared with both disposable and non-disposable trays as well as paper plates. The standard mess kit eating utensils, when compared with two other types of eating utensils, scored lowest for all of the four attributes. Finally, the standard metal canteen cup, when compared with a paper cup, scored lower for four out of five attributes. It can, therefore, be concluded that the standard mess kit is clearly disliked by consumers and a disposable system is much preferred.

For each mess gear component (tray, eating utensils, and drinking cups), there appeared to be agreement on what was most liked. In the tray/plate category the disposable tray was rated highest in overall acceptance and in each of the six attributes, and was the only component which received an overall positive rating. In the eating utensil category the plastic utensils were rated highest in overall acceptance and in three out of four attributes, while in the drinking cup category the paper cup was rated highest in overall acceptance and in four out of five attributes. The plastic eating utensils scored lower than dining facility utensils but higher than mess gear utensils in the "easy to cut with" category. The paper cup trailed the canteen cup only in the "large enough" category, but still received a positive rating. Therefore, when compared to the mess kit, the disposable tray is preferred without qualifications; the plastic eating utensils are preferred with some reservation about their cutting ability; and the paper cup is preferred with some reservation about its size. Both of these problems can be resolved by proper selection of plastic utensils and paper cups.

The cooks were also asked to compare the three alternative tray types with the standard metal mess kit. These data, which are summarized in Figure 1 of Appendix F indicate a strong preference for disposable trays and plates rather than the standard metal mess kit or the non-disposable metal tray. The only characteristic where the disposables were rated low concerned rubbish disposal. On the average, the cooks said that disposables would be slightly better in the number of KP's required and ease of serving the meal, and much better in terms of sanitation and the mess kit laundry line.

Conversely, the non-disposable metal tray was rated a little worse than the standard mess kit in the sanitation, storage, number of KP's and mess kit laundry line attributes. In each of these attributes the metal tray rating was far lower than that for either disposable.

Conclusions

1. The strong preference for the disposable tray by both the consumers and cooks indicates a uniformly high level of acceptance for this item.

2. The standard mess kit with utensils is considered unacceptable by consumers and much worse than the disposable tray by the cooks.

3. Personnel in remote and onsite areas did not differ in their ratings of the various types of mess gear.

CHAPTER X

FOOD SERVICE WORKER AND HUMAN ENGINEERING ANALYSIS

The behaviorally oriented assessment of the kitchen arrangement consisted of surveys and interviews of the sixteen food service personnel who worked in the XM-75 kitchen. A human engineering evaluation of the kitchen tent and equipment, the food containerization operation, and the pot washing operation was also conducted.

Worker Opinion of Equipment

The sixteen food service workers surveyed included E-5's, E-6's, E-7, and one warrant officer who was the project officer for the National Guard. Their field food service experience ranged from two months to 20 years. Four of the workers had combat food service experience. Their attitudes toward the military were positive with 75% of them stating that they liked the military moderately or very much and 87.5% stating that they would not like to transfer to duties other than food service.

In the interview, the cooks were asked for their preference between the battalion-size feeding concept and the company-size feeding operations with which they were more familiar. Not surprisingly, a strong preference was shown for the company-size concept (15 of 16, 94%). Major reasons given for this preference were that the food was better (6 of 16, 37.5%), the work was not as hard (5 of 16, 31%), and more personal attention could be given to the troops (4 of 16, 25%). It was also interesting to note that 6 out of 16 (37.5%) felt that the company kitchen was more efficient although the productivity of the XM-75 kitchen is 100% greater than the M-1948 kitchen. The one cook who preferred the battalion-size arrangement said that this crew was much better to work with than his usual company food service section. Supporting the contention that the workload was heavier was the response to a survey question which found all fifteen workers who had worked during the previous annual training saying that workload during the experiment was either more heavy (6,40%) or much more heavy (9, 60%).

The cooks unanimously expressed a preference for the new style of tent as opposed to the standard M-1948 Kitchen Tent. The major reason given related to size or space available (11 of 16, 69%). It should be remembered that the M-1948 tent is much smaller since it is designed to support a company kitchen. Three of the workers (19%) mentioned improved ventilation in the new tents while two (12.5%) cited the convenience of more than one doorway. (Four workers mentioned the equipment inside the tent as a reason for preferring the new tent, however, questions specifically concerning equipment will be addressed later in this chapter). It should be noted that one worker could, and in many instances did, give more than one response.

The first two interview questions provided additional data concerning both the good and bad aspects of the XM-75 tent from the worker's viewpoint Again, several of the workers (10 of 16, 62.5%) referred to the space or amount of room provided in which to work. Two cooks amplified this by commenting that they didn't bump into the other cooks. Seven workers (44%) also mentioned how cool the tent was compared to their memory of other field kitchens. Again, some cooks mentioned equipment - five of them (31%) singling out the new steam tables and four (25%) the griddles. There was only one negative comment made by more than one cook, and that related to ventilation. While recognizing that, in general, this tent was cooler than others, six workers (37.5%) still felt that more could be done to decrease the amount of heat. This problem might produce even more negative response in a hotter environment.

As stated earlier in this report, the kitchen tent was changed in the second week of the exercise by the addition of one section which increased the length from 32 to 40 feet. Also, the serving line arrangement was changed to place both lines at one end of the tent and the field ranges at the other end. The first survey question, which addressed worker opinion of various attributes of the field kitchen, was posed to workers at the end of each week of the study to determine which arrangement they preferred. The mean responses to this question are shown in Appendix F, Figure 1 and can be briefly summarized as follows: (a) the responses to every category were higher for the arrangement during the second arrangement, (b) the two largest differences of opinion concerning the two arrangements centered around the variable of amount of space. The second arrangement was also strongly preferred in the categories of temperature* and smoke and steam, (c) for the second arrangement alone, all categories were rated on the positive side of neutral with several of the mean ratings being quite strong.

Serving Line

One of the questions in the survey asked the workers if any pieces of equipment could be singled out as making their job easier or the food better. The overwhelming response indicated an extremely positive reaction to two parts of the serving line, the steam tables (15 of 16, 94% citing them) and the griddle (14 of 16, 87.5%). Three workers (19%) also mentioned the M-2 burners in preference to the "old" burners they used in past years - presumably the M-1937. On the other hand, seven cooks (44%) mentioned the burners when asked what piece of equipment had caused problems and/or could be changed for the better.

*This is partially related to adjustments made to channel heat from the griddles toward the tent roof away from the cooks. More specific comments will be made in the human factors section of this chapter.

Workers were also asked in the interview which serving line arrangement they preferred - the first week with lines at both ends of the tent or the second week with them both at one end. One cook worked only the second week and didn't respond to this question; of the other fifteen, fourteen (93%) preferred the second arrangement. Two main reasons were given for this preference, (a) having the serving area separated from the cooking area (5, 33%) and (b) not bumping into other workers as often (3, 20%).

Interview questions concerning specific likes about the serving line elicited responses which reinforce some of the responses already reported. The largest number of workers (12, 75%) mentioned the steam tables followed by six (37.5%) who cited the griddle. Three cooks (19%) also commented on the ease of serving the meal.

Despite this high level of acceptance for this second version of the serving line, there were some negative comments. Seven cooks (44%) complained about the heat from the griddle (four of these mentioned the steam tables also), specifically referring to intense heat given off at the groin level of the cooks working on the griddles. All agreed that the addition of a heat shield with exhaust vent had helped, but maintained that the heat remained uncomfortable. Notice was also taken by six workers (37.5%) of a bottleneck in the serving line caused where it extended about three feet past a door requiring customers to double back against traffic in order to exit.

Human Engineering

A human factors evaluation of the XM-75 kitchen tent, the new equipment used, the food containerization operation and the pot washing operation was conducted during the experiment by behavorial scientists from the Natick Research and Development Command. The nature of a human engineering analysis leads to most comments being centered on potential improvements for a system. It should be pointed out in this vein that the relatively high number of "negative" comments in this section do not lead to a conclusion that this system is a failure from the human engineering point of view. As a matter of fact, problems observed in the XM-75 field kitchen were fewer than were observed in other field kitchens on other Army and Marine exercises.[12]

[12]Meiselman, H.L., et. al., "Field Feeding: Behavioral Sciences Studies," US Army Natick Development Center Technical Report 76-3-FSL, January 1975.

The observation by the food service workers of the adequate space in the tent was verified. Particularly in the second configuration* with the extra eight feet of tent and the serving lines separated from the preparation area, there was ample space for the workers to move around without bumping into either equipment or each other. In this exercise, the tent was not used for storage purposes or filling insulated food containers. Adding this load to the tent in a field operation would place additional constraints on space as would moving the food containerization operation inside if this were necessary in bad weather and may create the need for additional workspace.

Environmentally, the tent was acceptable in most respects. Noise levels measured at various locations in the tent fell between 65 and 70 db(A). MIL-STD-1472 B specifies 75 db(A) as acceptable in a work area where verbal communication is required. Light levels were also taken at several locations. MIL-STD-1472 B cites an optimal level of illumination of 50 and a minimum of 30 foot candles for "normal" detail over prolonged periods. The light levels in the tent ranged from 25 to 75 foot candles depending on the locations of sun and shade. During daylight hours, tasks requiring attention to detail could be easily performed in any of the several well lighted areas.

The most critical environmental problem in most kitchens is temperature. MIL-STD-1472 B specifies a maximum of 85°F effective temperature** (ET) for prolonged exposure. Temperature measurements were taken using a sling psychrometer at waist level during the two weeks of the study at six different positions in the tent. Appendix G, Table 1 shows the highest and lowest effective temperatures obtained at each reading as well as the sun and shade ambients. For ambients of between 68° and 80°F (ET) temperatures in the kitchen ranged from 68.5° to 86.5°F. (ET). The only reading that exceeded the 85° limit was the one high reading on 14 August. As pointed out earlier, however, this situation may well deteriorate as ambient temperature becomes elevated. The other temperature shown in the table was taken at an approximate height of eight feet in the center of the tent. Although these temperatures were sometimes higher than those taken at waist level, this is to be expected. The critical point is that they are much lower than would be anticipated near the roof of a tent (and often not the highest temperature in the tent) indicating that the vents in the tent were serving their purpose.

*The first configuration did not provide ample space. However, the problem of workers colliding with each other and equipment could have been a function of the overall square footage, the work space arrangement, or both.

**An empirical thermal index based on dry bulb, wet bulb, and air movement in terms of the subjective feeling of warmth.

It is noteworthy, however, that measures taken at the eight foot height in a general purpose medium tent (being used for storage) with the sides completely raised and no burners being used yielded effective temperatures only slightly lower, and in one instance, even higher than in the XM-75 tent. The most severe temperature problem occurred with the griddles and is discussed later in this chapter.

Two other observations about the tent are appropriate. The easy access provided by the multiple doors contributed to the general ease of the work flow. In another category, the addition of some type of awning-like covering over the end of the tent used for the serving lines would protect the serving gear, utensils, napkins, etc., as well as sheltering some of the customers from either sun or precipitation.

As stated above, the superior arrangement in terms of space, work flow, and customer flow was the second configuration with the two serving lines in parallel separated from the preparation area. In addition to removing the heat generated by preparation to the far end of the tent, this arrangement also facilitated dual operations (i.e., serving one meal and initiating preparation of another simultaneously). The major problem in the XM-75 kitchen was that the serving line ended approximately three feet beyond the exit door causing congestion where customers doubled back in order to leave the tent. The self-service unit at the end of the line was particularly effective in providing shelf space at two levels, both within easy reach of the customers.

The steam tables provided a solution to one of the problems raised by food service workers in earlier studies of field feeding[13] keeping the food warm on the serving line. The steam tables used at Camp Edwards were 38 inches high measured to the lip. MIL-STD-1472 B specifies work "benches" must be 36 inches high ($\pm$ 0.5"). Standard human factors references [14] cite 36 inches as the optimum, but accept heights between 32 and 40 inches. Of course, workers do not serve directly from the steam table but from some serving vessel - typically the square head pan. The addition of this pan to the table results in a height of 42 inches which exceeds even the more liberal maximum. The steam tables also give off heat directed generally at the groin level of the server. During the exercise this heat fluctuated between 92° and 162°F dry bulb while the steam tables were in use. Perhaps the installation of a vent pipe

[13] Op. Cit. 12

[14] Van Cott, H.P. and Kinkade, R.G., editors, Human Engineering Guide to Equipment Design, US Government Printing Office, 1972.

similar to that employed on the griddle during the second week would help alleviate the problem.

The griddle had both positive and negative aspects from the human factors point of view. It was spacious enough for the required job, and according to the cooks, distributed heat evenly. It's height of 34.5 inches should probably be raised to one inch to satisfy MIL-STD-147 B. On the other hand, there were two more serious problems. The first concerned the grease trap itself. The slot for the trap was relatively small and several workers appeared to have difficulty directing the grease into it. Perhaps a larger slot, a bevelling toward the slot, or both would help. In addition, the grease container should be made larger so that removal would be necessitated less frequently. Removal itself was often difficult because of sticking.

The other problem, and a major one, concerned the heat directed toward the groin area of the cook. In the first week, before corrective venting was installed, dry bulb temperatures measured at groin height one foot from the griddle ranged from 170°F to 200°F, clearly dangerous and unacceptable. After the installation of the vent to direct the heat toward the roof of the tent and away from the cooks, temperatures ranged between 105° and 130°F - more acceptable, but still high for comfortable working conditions. (When the temperature was 129°F behind the griddle, it was 256°F at the top of the vent pipe).

Related to the temperature problem is the possibility of the cook receiving stomach burns from coming in contact with the griddle (one cook did get burned). The installation of a removable shield would prevent this, yet allow for efficient cleaning access. Ridges or guards around the griddle surface could be higher to prevent burns from grease splatter.

The stainless work tables were somewhat low (34 inches) but were, in general, a useful addition. The standard kitchen provides no such workplace and clearly the stainless tables are easier to clean than wood and, therefore, more acceptable from the sanitation point of view.

The M-2 Burners were the subject of recommendations in an earlier report.[15] Some additional observations were made on this exercise. The earlier report pointed out the virtual impossibility of the positioning of the safety gauge in the lower cooking position in the range. While logic would dictate that this would be improved in the higher cooking position, at Camp Edwards the cooks closed the sliding panels on the range, completely obscuring the gauge. Obversely when the burner was placed in the racks under the steam tables or griddles, the gauges were clearly visible. A final comment regarding education of the cooks

[15] Op. Cit. 12

concerning dealing with overpressurization should be made. As has occurred on other exercises, at Camp Edwards a cook (actually a steward) "solved" the problem by releasing vapors with the burner lighted, a procedure which has high potential for a serious fire and/or explosion. The correct procedure of complete shutdown should be more heavily stressed.

Lack of a hand washing facility or a facility which was clearly unsanitary is a problem that was also observed in other field exercises. No hand washing facility for the cooks was available in this exercise. Clearly, there is a relationship between cleanliness of the cooks hands and sanitation in the field kitchen. The addition of a sanitary hand washing facility either in or just outside the XM-75 tent is highly recommended.

Placing food in insulated containers for distribution to remote areas was one of the more inefficient operations of the exercise.[16] One of the major problems from a human factors point of view was the height at which the cooks had to work. The wooden table used for the operation was 29.75 inches high and the stainless steel table, 34.75 inches when the squarehead pan (7 inches height) was placed on the table, the working heights increased to either 36.75 inches or 41.75 inches. However, in practice, most of the containerizing was done using the large pot, which at 16 inches made the working heights 45.75 inches and 50-3/4 inches - both far beyond the military standard. At least one cook attempted to solve this problem by standing on a food case. The use of some sort of awning for this operation is also recommended both as a provider of shade for the cooks and protection for the operation in bad weather.

The use of a tent to house the pot washing operation to protect the workers and the equipment from the elements was far superior to traditional outside laundry lines. A major problem in the field has been that the large pot and the squarehead pan would not fit into the 32 gallon can in which they were supposed to be washed. The sinks constructed for use in the pot shack were a significant improvement in that these items could be totally immersed. However, the sinks were still not quite large enough to allow free access of the KP's hand and arm for washing. A test of a larger sink is recommended for further operations. Larger sinks would have an added benefit - three workers could work comfortably at the same time whereas now there is not quite enough room for three.

The height of the sink was another problem. The rim measured 34 inches from the ground, but the water surface was only 28-29 inches from the ground. Any prolonged washing activity will produce impaired performance at this height because of bending required; therefore,

---

[16] Op. Cit. 12

a height increase of 7 inches is recommended.

It was a simple worker operation to drain the sinks with the attached hoses; however, the hand-carry filling process using five gallon water containers was long, cumbersome, and potentially fatiguing. Some sort of pump arrangement is necessary to increase the efficiency of the operation. Not only would a pump make the job easier for the workers, but this relative ease of emptying and refilling would be more conducive to more frequent changes of dirty wash water.

The drying racks for the pots were a significant improvement over the complete lack of drying surfaces provided in the current field kitchen configuration.

Conclusions

1. The XM-75 tent was generally acceptable from the human factors point of view in terms of work space, noise, lighting, and temperature. The major positive aspects cited by the food service workers were the amount of room and the ventilation. The roof vents were particularly effective in controlling temperature in the roof area. However, some of the workers requested even more improvement in reducing heat, particularly that given off by the steam tables and griddle. Testing under higher ambient temperatures is recommended.

2. While all but one worker preferred the company-size feeding concept to the battalion-size, all of the workers interviewed preferred the XM-75 tent to the standard M-1948 tent.

3. The second week's arrangement with the larger tent and both serving lines at one end was superior to first week's, mostly because of increased space and separation of the serving and preparation areas.

4. The serving line was generally acceptable in terms of work flow. It did create a customer flow problem because the customer exit was not at the end of the line; however, this problem should be easily corrected.

5. The steam tables, while eliciting the most favorable comments of all the new equipment from the cooks did give off high levels of heat in the groin area of the worker and customer. Serving height from the squarehead pan in the steam table should be reduced approximately 6 inches.

6. The griddles were popular with the cooks, easy to use, and close to the correct height. Although venting greatly reduced the heat problem, temperatures at worker and customer groin level are still high. Larger grease slots, grease containers and ridges around the grill are recommended.

7. The stainless steel table is useful in terms of work efficiency and is a better alternative than the wooden field table because of the relative ease of sanitation.

8. The addition of a hand washing facility for the food service workers is essential for good personal hygiene of the cooks.

9. The working heights of the tables used in the food containerizing operation is far too high and requires the lowering of the work tables by as much as 15 inches.

10. The shelter and drying racks for the pot washing operation provide a significant improvement over current equipment and methods. The sinks should be increased slightly in size and raised 7 inches.

11. The entire XM-75 operation was, overall, a significant improvement from a human factors point of view over field kitchen operations evaluated in previous exercises.

APPENDIX A

EQUIPMENT PERFORMANCE

The experimental system at Camp Edwards utilized both standard TOE food service equipment and low cost-low risk commercial or development type items. The purpose of this Appendix is to discuss the performance of the commercial and development type items under field conditions noting modifications and/or improvements that could make for a better field item.

XM-75 Kitchen Tent

The kitchen shelter was considered by all to represent a big improvement over the current M-1948 kitchen tent. The multiple doors permitted the establishment of two serving lines inside the tent which is not possible in the M-1948 kitchen tent. The doorways, windows, and vents provided ventilation for the heat and gas vapors to escape. The fly above the tent was effective in keeping the hot sun off the tent and thus helped in making the kitchen cooler. The tent material, dynel, may not be strong enough for prolonged field use. Erecting the tent was considered by many to be easier than erecting an M-1948 kitchen tent.

The floor area in the expanded tent, 16'W x 40' L, was considered adequate by the cooks. However, the insulated food containers that carried prepared food to the field were filled on tables outside the kitchen tent. No attempt was made to perform this operation inside the tent under cover as would be necessary during inclement weather. The adequacy of the floor space in the XM-75 kitchen tent when assuming the additional responsibility of filling the insulated food containers will be determined during the next experiment.

Tables, Stainless Steel

The tables provided were unmodified commercial tables based upon the tapered hole and tapered split sleeve method of assembly. Assembly of the tables is time consuming and difficult for one person. When frequent assembly and disassembly are required, the split sleeves are a nuisance. They are difficult to maintain in position during assembly and are subject to being lost after disassembly. However, this system allowed very efficient packing of knocked-down tables for movement.

The height adjustment of the table leg foot plates is insufficient for field use, and the threaded plug at the base of each table leg is also unsatisfactory since the slightest bit of dirt caused galling and made adjustment difficult. Although these commercial tables were considered essential for effective kitchen operation and were well liked by the cooks, they require several modifications before they are suitable for field use.

NARADCOM Griddle

The griddle (NARADCOM developmental item) was designed around the table components (posts, shelves, split sleeves, etc.) and the griddle top was patterned after the griddle top used in the Mobile Kitchen Trailer. The griddle top fit onto the four posts with sleeves the same way as a table top. This item was very popular and often used despite various shortcomings and deficiencies. The most serious deficiency was the large amount of hot air that poured out from under the griddle top onto the midsections of the cooks (temperature in excess of 250°F). This was alleviated to a large degree by a quick field fix that drew off this hot air through a manifold and two 5" diameter stove pipes placed between

two adjacent griddles. These stove pipes stopped about 8" short of the tent roof, and the temperature of the exhaust air was hot enough to scorch the tent material. Deflectors were fabricated and installed to alleviate the scorching. Various other minor design modifications made apparent by the experiment include a larger grease catcher, a larger grease drain opening, quick interchangeability with the NARADCOM steam tables, and higher sides on the griddle to prevent spilling over.

NARADCOM Steam Tables

The steam table (NARADCOM development item) was designed for use with the squarehead field pan also around the table components. It replaced the table top. The steam table was very effective in maintaining the food on the line at the proper serving temperature. The steam table was also used for the heating of canned vegetables. Opened #10 cans of vegetables were placed in the water of the table and slowly brought up to the serving temperature. There was no boiling or stirring of vegetables. The resulting vegetables were superior in color and texture to those prepared in the conventional manner by heating and stirring in large batches in 10-or 15-gallon pots. Each steam table had a hose and drain to permit easy drainage and cleaning.

Field Sinks

The three field sinks (NARADCOM developmental item) utilized in the pot shack for sanitation purposes, were considered by all to be a big improvement over the standard GI cans with immersion heaters. The sinks were approximately two-feet square and deep which permitted the largest item, the 15-gallon pot to be immersed. However, the sinks should be about 6" longer so items like the 15-gallon pot can be turned sideways while in the sink for scrubbing purposes.

Water in the sinks was heated by M-2 burners placed under the sinks. The M-2 burners were ideal for keeping the water hot but were slow in heating the water up to the proper temperature, requiring approximately two hours.

The sinks must be redesigned to improve heat transfer by utilizing some of the hot air that is currently escaping to heat the water faster.

Wire Shelves

Commercially available open wire shelving was utilized in the pot shack for drying and storing of cleaned pots, pans, and utensils. The shelving was very useful and acceptable in all respects except that assembly and disassembly were extremely difficult. The shelving is subjected to potential bending since considerable hammering was required during the assembly and disassembly process. This particular design is unsatisfactory for field use since assembly and disassembly would be required with each kitchen move, and a different design will be needed if shelving is to be standardized for field use.

Lettuce Cutter

A commercial lettuce cutter was utilized. Some cooks preferred to use a cook's knife while other cooks swore by the lettuce cutter and claimed the cutter was about three times faster than a knife. In any case, the end product produced by the cutter was more uniform then that obtained using a knife. The lettuce cutter produced pieces that were bite size and which required no further cutting, a big advantage when disposable mess gear is used. Despite the difference of opinion the lettuce cutter has considerable potential.

Tomato Slicer

A commercial tomato slicer was also utilized. Opinions of the tomato slicer also varied. The slicer as designed is awkward for a right-handed person. The tomato slicer should be evaluated further, but some modifications should be considered. Redesigning so slicing is vertical to the table top rather than parallel and wedge cutting need to be considered.

Colanders and Strainers

Colanders and strainers are not standard field items yet there appears to be a need for such items. Small colanders and a 5-quart china cup were provided and were considered inadequate particularly when items like spaghetti, potatoes, etc., were prepared in 15-gallon pots. Many items such as partially cooked bacon and sausage, lettuce, dehydrated potatoes, etc., were prepared or cooked without draining.

Stirring Paddles

Stirring a 15-gallon pot of spaghetti, beef stew, or vegetables properly with standard issue utensils is almost impossible. Large aluminum food stirring paddles were procured for the second week. Every cook questioned felt the paddles were required items and should be a standardized for field use.

Spatulas

With eggs to order, steaks, chops, fish squares, etc., to be prepared on the griddle, cooks indicated the issue utensils were inadequate. Therefore, 3" x 6" spatulas with rosewood handles were provided. These spatulas were extremely popular and deemed a necessity for the kitchen.

Cutting Boards

The GSA cutting boards provided were unsatisfactory. They were satisfactory as cutting surfaces, but when immersed in hot water they became warped and twisted.

Butter Dispensers

The butter dispensers (eutectic pack type) provided, performed satisfactorily though not without fault. The glass, though tempered, is not suitable for the field. Butter chips often fell through the bottom of the dispenser. The dispensers are somewhat bulky and not suited for taking butter to the troops in the field. A suitable container should be provided for this purpose.

Pressure Sprayer

A pressure sprayer was provided for evaluation. The sprayer was effective for removing gross garbage from containers. When used in conjunction with a commercial oven cleaner (Easy-Off) it was possible to clean range cabinets effectively and rapidly. It was a popular item and extensively used. Usage control will be required if adopted as a field item due to its high rate of water and detergent consumption. Despite this disadvantage the use of a pressure sprayer in the field should be investigated further.

Hot Water

Providing an adequate timely supply of hot water in the field for sanitation purposes is a problem. The immersion heaters in the mess kit washline have to be lit 1 to 1-1/2 hours before the start of the meal period to insure the water being hot enough during the meal period for proper mess kit sanitation. Approximately 2 hours were required to heat the water in the field sinks up to the required temperature. This results in a large amount of non-productive time for the KP's assigned to the pot shack since they had to wait approximately 2 hours each time the water is changed. Assuming the water is changed after each meal this results in 6 hours of non-productive time per KP assigned to the pot shack per day. If a large supply of hot water could be supplied on a continuous basis, the non-productive time per pot shack KP could be greatly reduced.

During the second week of the experiment a hot water boiler from the standard 8-man shower head unit was utilized to provide hot water. Water was circulated from the 400-gallon water trailer through the boiler where it was heated and then returned to the water trailer. The temperature of the water in the trailer (400 gallons) was raised 100 degrees in approximately one hour.

Now whenever the water in the sinks became dirty the water was drained, the sinks cleaned and refilled with clean hot water from the 400-gallon water trailer. The washing of pots and pans began immediately as no time was lost waiting for the water to heat up. The M-2 burners under the sink were only used to maintain the water temperature.

The hot water boiler is also a lot more efficient in terms of gasoline usage. The boiler consumes 5 gallons of gasoline while raising the temperature of 400 gallons of water 100 degrees. Immersion heaters and M-2 burners consume approximately 0.5 gallons of gasoline per hour.

An immersion heater in a GI can takes about 1 hour time to heat 20 gallons of water about 100°F while the M-2 burners under the field sinks require about 2 hours to raise the 40 gallons of water temperature to 100°F. To heat 400 gallons of water in 20 G.I. cans by immersion heaters or in 10 field sinks by M-2 burners would require 10 gallons of gasoline. Since the boiler consumes only 5 gallons of gasoline while heating the same quantity of water it is twice as efficient.

The boiler method of heating water was preferred by all. KP's no longer had to wait for hot water and as a result cooks no longer had to wait long periods of time for clean pots and pans.

APPENDIX B

WORK SAMPLING DATA AND DEFINITIONS

TABLE B-1

JOB CLASSIFICATIONS

1. Supervisor: The E-7 or E-6 military supervisor in charge of operation of the field kitchen.

2. Military Cook: The E-5, E-4, E-3, or E-2 military person who performs cooking functions in the field kitchen.

3. K.P.: Military personnel assigned to the field kitchen who assist the cooks as directed.

TABLE B-2

TASK DEFINITIONS

1. Food Preparation

(1) Prepares for Cooking: Obtains ingredients. Opens food cans, boxes, and/or bags. Places raw or precooked items into appropriate cooking, heating or serving containers. Cuts meats and vegetables. Mixes ingredients as required.

(2) Cooks Food: Selects proper temperature settings, monitors food being cooked or reconstituted, and seasons food as required. Includes preparing eggs, hot cakes, french toast, meats, and other items on the serving line grill. Removes ready food from cooking utensils and places in serving or replenishing containers.

(3) Soups: Obtains ingredients, opens soup containers and mixes ingredients for soups. Cooks, seasons, and pours into serving containers or individual portions.

(4) Salads: Obtains ingredients. Cuts and cleans lettuce, cabbage, tomatoes, onions, and other salad ingredients. Mixes all salads and/or places salads in bulk or individual portions.

(5) Desserts: Obtains ingredients. Slices serving portions of cakes, pies, or other desserts. Includes preparing bulk or individual portions of puddings, custards, or fruits.

(6) Breads: Prepares toast, brown and serve rolls, and other pastry items prepared in the dining hall.

(7) Prepares Cooking Utensils: Includes all productive time required for obtaining and prelocating pots, pans, spatulas, and other cooking implements in preparation for cooking.

(8) Obtains Water for Cooking: Carries container to water buffalo, fills container with water, and carries container back to kitchen area.

2. Serving Food

(1) Serves Food: Cuts individual portions of meat on serving line. Serves patrons in line. Serves eggs, hot cakes, french toast, steaks, hamburgers, hot dogs, and other items directly from the serving line grill. (Note: When items are prepared on the line grill and placed in a serving container prior to being given to the patrons, the task will be recorded in the preparation category. Only when the items are served directly to the patrons from the grill will the task be carried in the category of serving food).

(2) Sets-up, Replenishes, and Tears Down Serving Line: Includes all time required to place, replenish, and remove food from the serving line. Prepares utensils for serving. Makes beverages. Refills milk and beverage dispensers.

(3) Prepares and Packs Insulated Containers: Preheats insulated food containers with hot water and fills with food for serving at remote areas.

3. Cleans Kitchen, Equipment, and Utensils

(1) Cleans Cooking Utensils: Washes pots, pans, and other cooking utensils. Returns pots, pans, and utensils to proper locations or receptacles.

(2) Cleans Equipment: Cleans ranges, preparation tables, steam kettles, grills, mixers, deep fryers, ovens, vegetable and meat cutting machines, and other equipment.

(3) Cleans Kitchen: Sweeps kitchen area. Cleans refrigerator, freezer, and dry goods storage area. Empties garbage, cleans garbage cans, and garbage areas; picks up litter around kitchen area.

(4) Cleans Insulated Containers: Cleans out food, washes and sanitizes insulated food containers upon their return from the field.

(5) Personal Hygiene: Engaging in any activity that would comprise good sanitation practice, such as washing hands after preparing raw meat, fish, poultry.

(6) Cleans Immersion Heaters: Cleans heaters after their disassembly.

(7) Obtains Water for Sanitation: Obtains water to wash equipment.

4. Maintains Laundry Line & M-2 Burners

(1) Sets up and Maintains Laundry Line for Mess Kit Sanitation: Includes filling cans with water and refueling and igniting immersion heaters.

(2) Sets up and Maintains Laundry Line for Sanitizing Pots, Pans, and Other Cooking Utensils: Includes filling cans with water and refueling and igniting immersion heaters.

(3) Transports and Distributes Prepared Food; Includes transporting insulated containers on vehicles and serving the food at the remote locations.

(4) Maintains and Refills M-2 Burners: Includes transporting burners to and from kitchen as well as refueling and igniting burners.

5. Supplies

(1) Picks up and Receives Supplies: Unloads all incoming supplies. Transports supplies to storage area. Uncrates, unpacks, and stores supplies in appropriate location. Maintains inventories and receipts for incoming food and expendable supplies.

(2) Maintains Supplies: Repositions stored supplies to insure that longest stored items are used first. Determines future subsistence requirements. Inventories supplies after each meal, daily, and when directed by food service supervisory personnel. Maintains supply records.

(3) Issues Supplies: Issues food supplies to senior cooks and records issues. Receives returned unused issues not used by cooks and annotates records indicating return. Buys out-of-stock items from other dining halls for immediate issue.

6. Administrative

(1) Prepares Correspondence and Records: Drafts and types correspondence. Prepares various food control records. Maintains civilian employees personnel and pay records.

(2) Telephone/Radio: Answers telephone and radio and pages personnel.

7. Supervisory

(1) Monitors Reports and OJT Program: Monitors the preparation of required forms by senior cooks and shift leaders. Gives the monitors OJT.

(2) Coordinates: Coordinates with other dining halls and base units on food requirements.

(3) Inspects: Inspects dining hall to assure cleanliness and maintenance of good sanitation practices.

(4) Gives Supervision: A Dining Hall Supervisor or Civilian Shift Leader gives instructions to another Dining Hall employee (other than OJT).

(5) Receives Supervision: An employee receives instructions from a Dining Hall Supervisor or Civilian Shift Leader.

8. Mess Check

(1) Cash Collection and Headcount: Checks customers ID's, that headcount sheets are signed and monies collected when required.

9. Miscellaneous

(1) OJT: Receives OJT.

(2) Maintenance: Performs minor maintenance on facility and equipment.

10. Non-Productive

(1) Designated Rest Break: Consists of those times that are for employee coffee breaks or other assigned rest periods.

(2) Other: Consists of all non-productive activities not defined elsewhere.

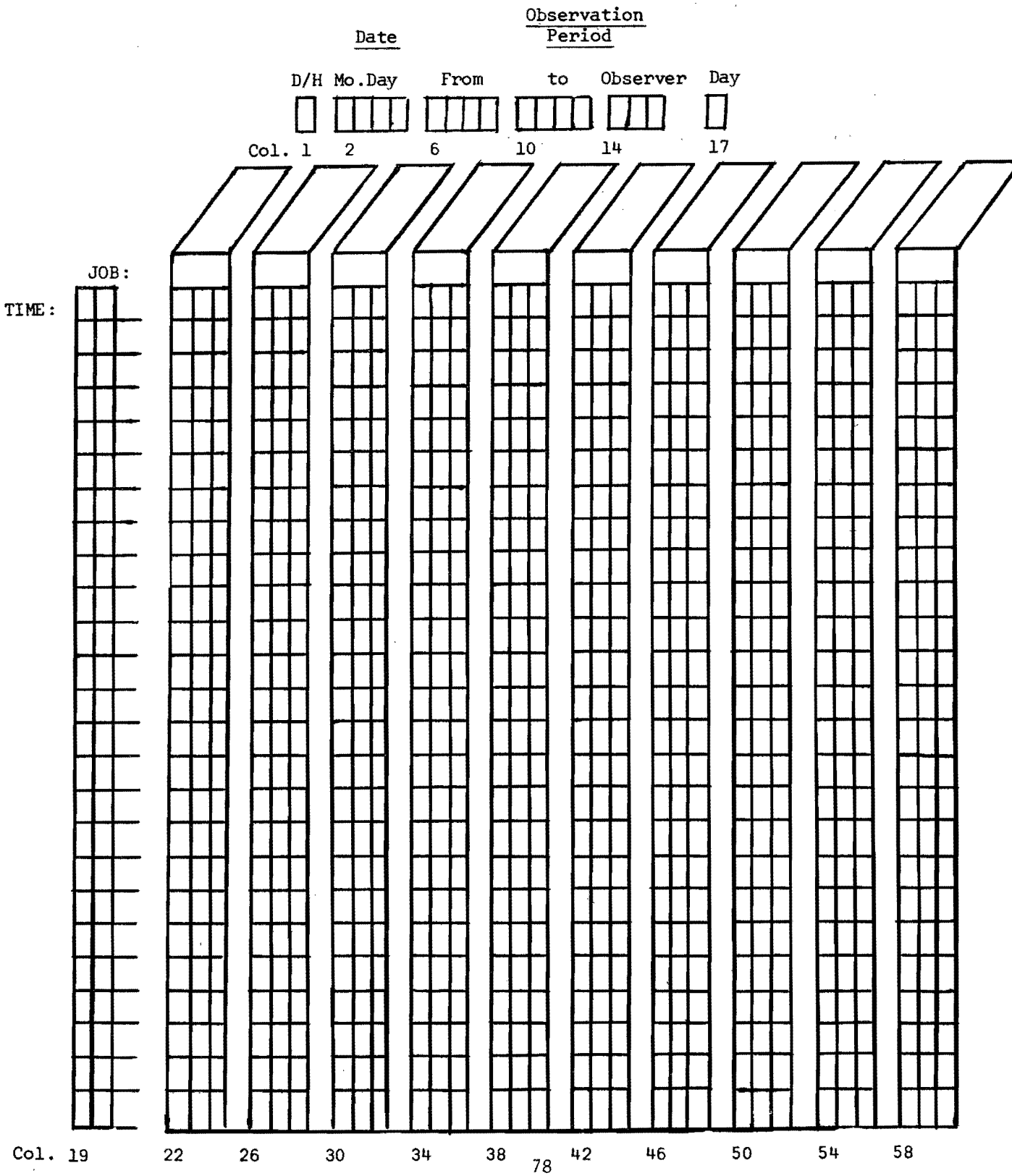
(3) Absent: Employee is not to be found on the premises.

(4) Walking: Employee is walking from one area to another, or within an area without any apparent purpose.

Figure B-1

WORK SAMPLING STUDY - CAMP EDWARDS

DATA COLLECTION SHEET



APPENDIX C

FOOD OPERATIONS DATA AND MENU

MEAL DAY	BREAKFAST	LUNCH	SUPPER	TOTAL
001	.51	.92	.95	2.40
002	.52	2.51	.87	3.90
003	.56	1.22	1.34	3.13
004	.59	.74	.96	2.29
005	.65	.89	.88	2.43
006	.60	.88	1.23	2.71
007	.64	.87	1.00	2.52
008	.52	.97	.67	2.17
009	.57	.96	.86	2.40
010	.53	.88	1.13	2.55
011	.61	.83	.97	2.41
012	.54	.79	.75	2.09
013	.70	.58	2.59	3.88
014	.51	.92	1.31	2.76
AVE	.58	1.00	1.11	2.69
PCT	21.56	37.17	41.26	100.00

Figure C-1, Cost Summary

MENU DAY	FOOD ENERGY (K CAL)	PROTEIN (GM)	FAT (GM)	CALCIUM (MG)	IRON (MG)	VTMN A (IU)	THIAMINE (B1 MG)	RIBO FLAVIN (B2 MG)	NIACIN (MG)	ASCORBIC ACID (C MG)
1	891	45.0	45.3	503	6.48	2420	1.01	1.03	6.1	84.0
2	1094	34.5	56.9	558	4.96	2451	.97	.89	4.7	106.7
3	1355	39.0	62.4	512	6.71	2474	.86	.96	3.9	19.5
4	1404	38.3	69.1	594	6.08	2683	1.09	.99	5.5	92.8
5	1545	46.6	72.4	615	7.99	2236	1.25	1.07	5.8	24.0
6	1305	48.2	61.4	498	7.67	2720	1.21	1.11	6.9	89.7
7	1505	40.0	64.4	648	7.92	2175	1.28	1.12	6.7	52.9
8	1158	38.7	51.3	519	7.73	3594	.89	1.06	5.8	56.3
9	1335	40.5	58.0	650	6.97	2466	1.11	1.09	5.4	117.3
10	1340	37.6	68.3	501	5.79	2915	.76	.98	4.2	89.6
11	1364	38.7	69.2	591	7.40	3694	1.11	1.01	6.2	48.0
12	1357	45.3	63.2	522	6.60	2557	.91	1.07	4.5	88.3
13	1562	49.5	79.4	597	8.47	2489	1.39	1.06	7.5	23.8
14	1234	37.1	59.4	493	6.03	2720	.87	1.00	4.6	89.7
DDA/3	1133	33.3	50.3	266	4.67	1667	.57	.67	7.3	20.0
AVE	1319	62.9	41.4	557	6.91	2685	1.05	1.03	5.6	70.2
PCT	116.42	188.89	70.62	208.85	147.97	161.07	184.21	153.73	76.40	351.00

Figure C-2 Nutrition Summary: Breakfast

MENU DAY	FOOD ENERGY (KCAL)	PROTEIN (GM)	FAT (GM)	CALCIUM (MG)	IRON (MG)	VITMN A (IU)	THIAMINE (B1 MG)	RIBO FLAVIN (B2 MG)	NIACIN (MG)	ASCORBIC ACID (C MG)
1	1765	69.7	94.4	1041	8.34	3978	1.27	1.33	11.2	64.6
2	1981	71.1	106.7	664	11.70	3159	1.42	1.23	14.3	116.6
3	1758	51.0	97.5	506	8.23	2398	1.84	1.11	11.4	45.1
4	1642	51.7	78.2	564	10.87	5175	1.48	1.02	11.3	85.7
5	1712	72.0	69.2	577	9.57	2558	1.49	1.51	18.9	52.0
6	1475	45.2	86.7	531	9.29	7436	1.43	.89	8.2	70.8
7	1874	68.8	86.5	726	9.18	2603	1.71	1.12	16.3	45.1
8	1676	67.3	84.5	1030	9.02	4205	1.45	1.25	10.4	71.8
9	1790	60.7	91.8	729	9.92	2525	1.46	1.12	10.8	57.9
10	1530	57.0	57.4	583	12.62	6237	1.44	1.08	12.7	101.5
11	1720	49.6	105.2	601	9.94	4340	1.36	.96	9.4	61.9
12	1465	68.5	53.5	618	8.47	13712	1.49	1.40	17.5	27.5
13	1393	35.7	75.6	522	7.98	10050	1.33	.89	7.8	84.3
14	1970	56.4	98.3	1047	5.64	4069	1.38	1.23	5.3	41.2
DD A/3	1133	33.3	50.3	266	4.67	1667	.57	.67	7.3	20.0
AVE	1597	84.7	58.9	696	9.34	5175	1.47	1.15	11.8	66.1
PCT	149.78	254.35	78.10	260.97	200.00	310.44	257.89	171.64	160.98	330.50

Figure C-3. Nutrition Summary: Lunch

MENU DAY	FOOD ENERGY (KCAL)	PROTEIN (GM)	FAT (GM)	CALCIUM (MG)	IRON (MG)	VTMN A (IU)	THIAMINE (B1 MG)	RIBO FLAVIN (B2 MG)	NIACIN (MG)	ASCORBIC ACID (C MG)
1	1529	57.9	87.1	651	8.48	14612	1.34	1.17	10.3	77.4
2	1856	68.9	87.4	574	9.49	2717	1.57	1.35	18.2	57.0
3	1452	61.4	68.1	599	10.88	4073	1.43	1.00	11.0	75.5
4	1758	51.0	74.9	599	12.57	10907	1.89	1.13	10.1	41.7
5	1623	53.0	75.4	542	10.24	3481	1.68	1.03	10.5	42.4
6	1755	62.5	73.3	542	9.89	15044	1.38	1.20	12.7	39.7
7	1788	44.7	76.4	668	6.72	4351	1.42	1.01	8.9	105.4
8	1697	47.5	76.3	733	8.33	14208	.91	1.05	6.4	30.5
9	1667	67.0	77.1	663	7.66	4208	1.34	1.39	17.1	55.1
10	1585	61.5	80.1	635	8.88	3497	1.41	1.23	12.2	99.5
11	1858	59.9	69.2	623	13.02	3443	1.80	1.11	10.4	38.0
12	1578	47.7	84.3	551	7.46	6442	1.23	1.03	8.8	50.9
13	2020	74.1	104.8	658	11.99	3840	1.38	1.32	14.8	91.9
14	2030	56.5	121.0	661	10.28	3596	2.17	1.28	12.1	47.4
DDA/3	1133	33.3	50.3	266	4.67	1667	.57	.67	7.3	20.0
AVE	1729	82.5	58.1	621	9.71	6744	1.50	1.16	11.7	60.9
PCT	152.60	247.75	75.61	232.85	207.92	404.56	263.16	173.13	159.62	304.50

Figure C-4, Nutrition Summary: Supper

MENU DAY	FOOD ENERGY (K CAL)	PROTEIN (GM)	FAT (GM)	CALCIUM (MG)	IRON (MG)	VTMN A (IU)	THIAMINE (B1 MG)	RIBO FLAVIN (B2 MG)	NIACIN (MG)	ASCORBIC ACID (C MG)
1	4185	172.5	226.8	2195	23.29	21010	3.62	3.53	27.7	226.0
2	4931	174.6	251.0	1796	26.14	8327	3.96	3.47	37.3	280.3
3	4576	151.4	228.1	1618	25.82	8945	4.13	3.07	26.3	140.2
4	4804	141.0	222.2	1757	29.52	18765	4.47	3.14	26.8	220.2
5	4881	171.5	217.0	1733	27.80	8276	4.43	3.61	35.2	118.4
6	4535	155.9	221.5	1571	26.85	25201	4.02	3.19	27.8	200.2
7	5167	153.5	227.3	2042	23.82	9129	4.41	3.25	31.9	203.4
8	4530	153.5	212.1	2281	25.08	22007	3.26	3.36	22.6	158.6
9	4791	168.2	226.8	2043	24.55	9200	3.91	3.60	33.3	230.3
10	4455	156.2	205.8	1719	27.29	12649	3.61	3.29	29.1	290.5
11	4951	148.2	243.5	1814	30.36	11477	4.27	3.08	26.0	147.9
12	4401	161.5	200.9	1691	22.53	22710	3.62	3.50	30.7	166.6
13	4974	159.4	259.8	1777	28.45	16380	4.10	3.27	30.1	200.0
14	5234	150.0	278.7	2201	21.95	10386	4.41	3.52	22.0	178.3
DDA	3400	100.0	151.0	800	14.00	5000	1.70	2.00	22.0	60.0
AVE	4744	230.1	158.4	1874	25.96	14604	4.02	3.35	29.1	197.2
PCT	139.53	230.10	75.13	234.25	185.43	292.08	236.47	167.50	132.27	328.67

Figure C-5 Nutrition Summary

TABLE C-6

Technical Quality of Plated Food

Date	Meal	Entree	Rating	Temp	Ounces	Starch	Rating	Temp	Ounces	Vegetable	Rating	Temp	Ounces
9 Aug	L	Cheeseburgers	6	-	-	Lyonn. Pot.	6	-	-	Corn	6	-	-
	D	Pot Roast	6	104	2.6	Mashed	3	109	6.2	-	-	-	-
10 Aug	L	Grilled Steak	5	93	4-6	Baked	7	100	2-7	Green Beans	5	113	2.6
	D	Fried Chicken	-	-	-	Mashed	6	116	9.5	Peas	5	105	3.0
11 Aug	L	Pork Slices	6	106	4.6	Mashed	6	114	3.5	Mex. Corn	6	-	1.6
	D	Swiss Steak	6	138	6.2	O'Brien	6	108	2.0	Peas	6	96	-
12 Aug	L	Spaghetti/Sauce	4	132	14.4	None	-	-	-	Wax Beans	6	106	1.2
	D	Baked Ham	7	122	4.6	Sweet Pot.	4	128	-	Green Beans	5	108	2.0
13 Aug	L	Fried Chicken	7	128	5.0	Mashed	6	138	4.6	Corn	6	122	5.0
	D	Chop Suey	6	124	11.0	Pot. Salad	5	72	-	Peas	6	122	3.2
14 Aug	L	Beef Stew	5	160	7.0	None	-	-	-	Green Beans	7	115	2.2
	D	Roast Beef	7	100	3.0	Mashed	6	116	5.8	Peas & Carrots	6	108	2.4
15 Aug	L	Roast Turkey	7	89	7.2	Mashed	6	148	5.2	Wax Beans	6	114	2.8
	D	-	-	-	-	-	-	-	-	-	-	-	-
18 Aug	L	Spag./Ital.Sauc	6	110	7.0	None	-	-	-	Peas w/onions	6	-	3.2
	D	Pot Roast	7	110	6.4	Mashed	6	130	4.8	Corn	7	115	2.2
*19 Aug	L	Fried Chicken	4	103	3.4	Mashed	6	123	3.8	Carrots	6	109	3.2
*	D	BBQ Beef Cubes	-	135	3.9	O'Brien	6	140	2.1	Peas	6	120	3.3
*20 Aug	L	Grilled Ham	6	92	4.2	Baked Beans	6	112	4.5	Green Beans	5	96	7.0
	D	Beef Stew	-	160	-	None	-	-	-	Corn	-	150	-
21 Aug	L	Am. Chop Suey	6	130	9.8	None	-	-	-	Peas & Carrots	6	96	3.0
	D	Grilled Steak	7	112	7.0	Baked	7	180	10.8	-	-	-	-

*Due to a supply problem, the order of these three meals differs from that called for by the menu.

TABLE C-6 (Cont'd)

Technical Quality of Plated Food

Date	Meal	Salad	Rating	Temp	Ounces	Dessert #1	Rating	Temp	Ounces	Dessert #2	Rating	Temp	Ounces
9 Aug	L	-	-	-	-	Choc. Sundae	7	-	-	None	-	-	-
	D	Tossed	6	-	3.8	Straw. Shortcake	6	-	-	None	-	-	-
10 Aug	L	Tossed Veg.	7	-	2.0	Straw. Sundae	7	-	3.0	Fruit Cocktail	8	70	4.2
	D	Spring	3	-	1.5	-	-	-	-	Fruit Cocktail	6	84	4.0
11 Aug	L	Let. & Tom.	6	76	4.4	Vanilla Cookies	5	-	1.5	Peaches	6	77	5.8
	D	Tossed Green	7	-	3.4	Apple Crisp	5	-	-	-	-	-	-
12 Aug	L	Tossed	6	82	3.0	Cookies	5	-	1.9	Pears	7	78	1.6
	D	Lettuce	6	-	-	Butterscotch Br	5	-	-	Fruit Cocktail	7	78	1.6
13 Aug	L	Tomato	7	-	-	White Cake	7	-	2.2	None	-	-	-
	D	Tom. & Cuke	6	-	-	-	-	-	-	Peaches	7	-	-
14 Aug	L	Let. & Tom.	7	80	3.8	Sugar Cookies	7	-	-	-	-	-	-
	D	Let. & Tom.	6	78	4.8	Cherry Pie	6	-	9.0	None	-	-	-
15 Aug	L	-	-	-	-	Pineap. Upsi. Dn	7	-	3.2	None	-	-	-
	D	-	-	-	-	-	-	-	-	-	-	-	-
18 Aug	L	Tossed	6	78	3.4	Choc. Brownie	7	-	-	Peaches	6	76	4.2
	D	Tom. & Egg	6	66	-	-	-	-	-	Peaches & Pears	7	72	3.2
19 Aug	L	Let. & Tom.	6	63	4.6	Choc. Brownie	6	-	2.2	None	-	-	-
	D	Tos. Veg.	7	45	0.7	Cookies	6	-	1.4	Fruit Cocktail	7	50	3.9
20 Aug	L	Tossed	6	73	3.2	Hermits	-	58	3.0	Pears	-	49	3.0
	D	Tos. Veg.	-	50	-	Cookies	7	-	1.0	Fruit Cocktail	7	57	3.8
21 Aug	L	Tossed	7	70	4.4	Choc. Cake	6	-	-	None	-	-	-
	D	Tos. & Cuke	7	65	4.2	Devils Food Cake	6	-	3.6	None	-	-	-

TABLE C-6 (Cont'd)

Technical Quality of Plated Food

Date	Meal	Cold Bev.	Rating	Temp	Ounces	Miscellaneous	Rating	Temp	Ounces	Overall Meal Rating	Selected Breakfast Items	Rating	Temp	Ounces
9 Aug	L	-	-	-	-	-	-	-	-	6	-	-	-	-
	D	-	-	-	-	Gravy	5	-	-	6	-	-	-	-
10 Aug	L	Chocolate Milk	7	62	8.5	-	-	-	-	-	Toast (2)	4	110	1.5
	D	Iced Tea	6	60	-	Gravy	6	-	-	6	Half Gr. Fruit	6	50	6.0
11 Aug	L	Orangeade	6	63	-	Applesauce	7	67	3.8	6	Scram. Eggs	5	135	-
	D	Grapeade	6	68	7.0	White Bread	7	-	0.8	6	Cinnamon Roll	5	-	-
12 Aug	L	Grapefruit	6	71	7.2	French Bread	6	-	1.0	4	Fried Eggs (2)	8	-	3.2
	D	Grapeade	6	58	6.8	Chile Mustard Sauce	7	-	-	6	Hash Br. Potatoes	6	110	4.5
13 Aug	L	Iced Tea Punch	7	50	6.6	Biscuit	5	-	1.0	7	-	-	-	-
	D	Iced Tea	6	-	-	Rice	7	116	-	6	-	-	-	-
14 Aug	L	Orangeade	6	-	-	Pan Rolls	6	-	-	5	Coffee	8	140	6.7
	D	Grapeade	6	50	9.4	-	-	-	-	6	Orange Juice	8	50	8.1
15 Aug	L	Lemonade	7	44	9.4	Stuffing	6	126	5.4	6	Sausages (2)	6	104	1.8
	D	-	-	-	-	-	-	-	-	-	French Toast (2)	6	90	3.5
18 Aug	L	Lemonade	7	56	8.8	Milk	7	52	8.5	6	Fried Eggs (2)	7	106	3.2
	D	Grapeade	7	38	-	White Bread	6	-	0.7	6	Sweet Roll	4	76	4.7
19 Aug	L	Lemonade	7	-	8.6	Gravy	6	-	-	5	Hash Br. Potatoes	7	96	2.3
	D	-	-	-	-	Coffee	6	140	8.5	-	Bacon	6	80	0.5
20 Aug	L	Lemonade	7	48	9.0	Milk	7	55	8.5	6	Toast (1)	4	79	0.7
	D	-	-	-	-	-	-	-	-	-	Scram. Egg	6	126	4.2
21 Aug	L	Orangeade	6	42	7.9	Vinegar & Oil Dr.	7	-	-	-	Baked Ham	8	129	1.8
	D	Grapeade	6	52	9.0	Cucumbers	6	-	1.0	7	Apple Juices	8	42	8.5

NATIONAL GUARD CAMP EDWARDS

MENU

REVISED BY NARADCOM & 101ST ENG 7 JULY 1975

R1

MENU I - SATURDAY 9 August 1975

Dinner

Cheeseburgers/Hamburgers (L-32)
Catsup - Mustard
Pickle Relish
Lyonnaise Potatoes (Q-54)
Buttered Corn (Q-G-3)
Lettuce and Tomato (M-33)
Sliced Onions
Garlic French Dressing (M-60)
Hamburger Buns (Issued)
Chocolate Nut Sundae (K-5)
Coffee (C-4)
Tea
Cocoa
Lemonade
Milk

Supper

Pot Roast (L-9)
Mashed Potatoes (Q-57)
Buttered Carrots (Q-G-1)
Garden Vegetable Salad (M-19)
Vinaigrette Dressing (M-71)
Assorted Breads
Butter
Strawberry Sundae (K-5)
Coffee (C-4)
Tea
Cocoa
Iced Tea (C-14)
Milk

MENU II - SUNDAY 10 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Grilled Steak (L-7)	Country Style Chicken (L-135)
Chilled Grapefruit Half	Baked Potato (Q-44)	Gravy (O-16)
Maraschino Cherries	Green Beans (Q-G-1)	Cranberry Sauce
Ready-to-Eat Cereal	Tossed Green Salad (M-47)	Mashed Potatoes (Q-57)
Eggs to Order (F-6 thru F-13)	Chiffondale Dressing (M-53)	Buttered Peas (Q-G-1)
Baked Bacon Slices (L-2)	Pan Rolls (D-33)	Spring Salad (M-44)
Hashed Brown Potatoes (Q-54)	Butter	Tasty French Dressing (M-69)
*Toast	Strawberry Shortcake (G-16)	French Bread
Butter	Whipped Topping (K-16)	Butter
Jam or Jelly	Coffee (C-4)	Fruit Bar (H-7)
Coffee (C-4)	Tea	Fruit Cocktail
Tea	Cocoa	Coffee (C-4)
Cocoa	Iced Tea (C-14)	Tea
Milk	Milk	Cocoa
		Iced Tea (C-14)
		Milk

* These two items are substituted for the canned juices and plain bread that would normally be served in a field menu for all breakfasts.

MENU III - MONDAY 11 August 1975

Breakfast	Dinner	Supper
*Chilled Apple Juice	Baked Pork Slices (L-83)	Swiss Steak w/Tomato Sauce (L-16)
Fresh Bananas	Applesauce	O'Brien Potatoes (Q-54)
Ready-to-Eat Cereal	Mashed Potatoes (Q-57)	Buttered Peas (Q-G-1)
Eggs to Order (F-6 thru F-13) Away Scrambled	Mexican Corn (Q-27)	Tossed Green Salad (M-47)
Baked Bacon Slices (L-2)	Lettuce Salad (M-32)	Chilean Dressing (M-54)
Cinnamon Rolls (D-36-2-3)	Green Salad Dressing (M-61)	Assorted Breads
*Toast	Assorted Breads	Butter
Butter	Butter	Apple Crisp (J-1)
Jam or Jelly	Chocolate Cookies (H-26)	Coffee (C-4)
Coffee (C-4)	Chilled Peaches	Tea
Tea	Coffee (C-4)	Cocoa
Cocoa	Tea	Iced Tea (C-14)
Milk	Cocoa	Milk
	Orangeade	
	Milk	

MENU IV - TUESDAY 12 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Spaghetti w/Meat Sauce (L-38)	Baked Ham (L-69)
Fresh Apples	Grated Cheese	Chili Mustard Sauce (O-4)
Ready-to-Eat Cereal	Buttered Wax Beans (Q-G-1)	Candied Sweet Potatoes (Q-67)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Tossed Vegetable Salad (M-48)	Buttered Green Beans (Q-G-1)
Baked Bacon Slices (L-2)	Vinegar and Oil Dressing (M-72)	Lettuce Salad (M-32)
Home Fried Potatoes (Q-54)	French Bread	Lamaze Dressing (M-62)
Coffee Cake (D-13)	Butter	Pan Rolls (D-33)
*Toast/Butter	Hermits (H-17)	Butter
Jam or Jelly	Chilled Pears	Butterscotch Brownies (H-3-2)
Coffee (C-4)	Coffee (C-4)	Chilled Fruit Cocktail
Tea	Tea	Coffee (C-4)
Cocoa	Cocoa	Tea
Milk	Lemonade	Cocoa
	Milk	Iced Tea (C-14)
		Milk

MENU V - WEDNESDAY 13 August 1975

Breakfast	Dinner	Supper
*Chilled Apple Juice	Fried Chicken (L-135)	Pork Chop Suey (L-80)
Chilled Grapefruit Sections	Mashed Potatoes (Q-57)	Chow Mein Noodles
Ready-to-Eat Cereal	Buttered Corn (Q-C-3)	Steamed Rice (E-5)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Spring Salad (M-44)	Buttered Peas (Q-G-1)
Baked Sausage Links (L-88)	French Dressing (M-58)	Tossed Green Salad (M-47)
Hashed Brown Potatoes (Q-54)	Biscuit (D-10)	Russian Dressing (M-67)
Hot Cross Buns (D-26-1)	Butter	Assorted Breads
*Toast	Chocolate Brownies (H-2-1)	Butter
Butter	Coffee (C-4)	Sugar Cookies (H-27)
Jam or Jelly	Tea	Chilled Peaches
Coffee (C-4)	Cocoa	Coffee (C-4)
Tea	Iced Tea (C-14)	Tea
Cocoa	Milk	Cocoa
Milk		Iced Tea (C-14)
		Milk

MENU VI - THURSDAY 14 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Beef Stew (L-22)	Roast Beef (L-5)
Fresh Banana	Buttered Green Beans (Q-G-1)	Natural Pan Gravy (O-18)
Ready-to-Eat Cereal	Lettuce and Tomato Salad (M-33)	Mashed Potatoes (Q-44)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Vinaigrette Dressing (M-71)	Parsley Buttered Carrots (Q-G-1)
Baked Ham Slices (L-65)	Assorted Breads	Garden Vegetable Salad (M-19)
Coffee Cake (D-13)	Butter	French Dressing (M-58)
*Toast	Oatmeal Cookies (H-23)	Pan Rolls (D-33)
Butter	Chilled Fruit Cocktail	Butter
Jam or Jelly	Coffee (C-4)	Cherry Cobbler (I-25)
Coffee (C-4)	Tea	Coffee (C-4)
Tea	Cocoa	Tea
Cocoa	Iced Tea (C-14)	Cocoa
Milk	Milk	Grapeade
		Milk

MENU VII - FRIDAY 15 August 1975

Breakfast	Dinner	Supper
*Chilled Apple Juice	Roast Turkey (L-142)	Fried Fish Portions (L-111)
Fresh Orange	Gravy (O-16)	Seafood Cocktail Sauce (O-11)
Ready-to-Eat Cereal	Savory Bread Dressing (O-21)	Lemon Wedges
Eggs to Order (F-6 thru F-13)-Away Scrambled	Cranberry Sauce	O'Brien Potatoes (Q-54)
French Toast w/Hot Maple Syrup (D-22)	Mashed Potatoes (Q-57)	Buttered Peas (Q-G-1)
Baked Bacon Slices (L-2)	Buttered Wax Beans (Q-G-1)	Tossed Vegetable Salad (M-48)
Hash Brown Potatoes (Q-54)	Lettuce Salad (M-32)	French Dressing (M-58)
Sweet Rolls (D-36)	Thousand Island Dressing (M-70)	Assorted Breads
*Toast/Butter	Radishes	Hot Cornbread (D-14)
Jam or Jelly	Assorted Breads	Butter
Coffee (C-4)	Butter	Ice Cream
Tea	Pineapple Upside Down Cake (G-29-2)	Peach Cobbler (I-38)
Cocoa	Coffee (C-4)	Coffee (C-4)
Milk	Tea	Tea
	Cocoa	Cocoa
	Iced Tea (C-14)	Grapeade
	Milk	Milk

MENU VIII - SATURDAY 16 August 1975

Breakfast	Dinner	Supper
*Chilled Tomato Juice	Cheeseburger/Hamburger (L-32)	Simmered Frankfurters (L-63)
Chilled Grapefruit Half	Catsup - Mustard	Catsup - Mustard
Ready-to-Eat Cereal	Pickle Relish	Pickle Relish
Eggs to Order (F-6 thru F-13)	O'Brien Potatoes (Q-54)	Baked Beans (Q-2)
Baked Bacon Slices (L-2)	Buttered Green Beans (Q-G-1)	Buttered Carrots (Q-G-1)
Doughnuts (Issued)	Lettuce and Tomato Salad (M-33)	Lettuce Salad (M-32)
*Toast/Butter	Sliced Onion	Chopped Onions
Jam or Jelly	French Dressing (M-58)	Lamaze Dressing (M-62)
Coffee (C-4)	Hamburger Buns (Issued)	Frankfurter Rolls (Issued)
Tea	Ice Cream	Ice Cream
Cocoa	Chocolate Cake (G-12-2)	White Cake (G-30-1)
Milk	Butter Cream Icing (G-47)	Butter Cream Icing (G-47)
	Coffee (C-4)	Coffee (C-4)
	Tea	Tea
	Cocoa	Cocoa
	Iced Tea (C-14)	Orangeade
	Milk	Milk

MENU IX - SUNDAY 17 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Cold Cuts (Ham,Roast Beef, & Turkey)	Barbecued Chicken (L-128)
Fresh Orange	Potato Salad (M-40)	Mashed Potatoes (Q-54)
Ready-to-Eat Cereal	Baked Beans	Corn O'Brien (Q-27)
Eggs to Order (F-6 thru F-13)	Buttered Wax Beans (Q-G-1)	Tossed Green Salad (M-47)
Griddle Cakes w/Hot Maple Syrup (D-25)	Lettuce Salad (M-32)	Piquant Dressing (M-68)
Baked Sausage Links (L-88)	Chiffenade Dressing (M-53)	Assorted Breads
Coffee Cake (D-13)	Assorted Breads	Butter
*Toast/Butter	Butter	Ice Cream
Jam or Jelly	Ice Cream	Cookies (Issued)
Coffee (C-4)	Yellow Cake (G-32)	Chilled Fruit Cocktail
Tea	Chocolate Butter Cream Icing (G-39-2)	Coffee (C-4)
Cocoa	Coffee (C-4)	Tea
Milk	Tea	Cocoa
	Cocoa	Iced Tea (C-14)
	Iced Tea Punch (C-15)	Milk
	Milk	

MENU X - MONDAY 18 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Spaghetti with Italian Sausage Sauce (L-38 Mod)	Pot Roast (L-9)
Fresh Banana	Grated Cheese	Mashed Potatoes (Q-57)
Ready-to-Eat Cereal	Peas with onions (Q-41)	Buttered Corn (Q-G-3)
Eggs to Order (F-6 thru F-13)	Spring Salad (M-44)	Lettuce and Tomato Salad (M-33)
Baked Bacon Slices (L-2)	French Dressing (M-58)	Russian Dressing (M-67)
Sweet Rolls (D-36)	Assorted Breads/Butter	Assorted Breads
*Toast/Butter	Butterscotch Brownies (H-3-2)	Butter
Jam or Jelly	Chilled Peaches	Strawberry Sundae (K-5)
Coffee (C-4)	Coffee (C-4)	Chilled Pears
Tea	Tea	Coffee (C-4)
Cocoa	Cocoa	Tea
Milk	Lemonade	Cocoa
	Milk	Iced Tea (C-14)
		Milk

MENU XI - TUESDAY 19 August 1975

Breakfast	Dinner	Supper
*Chilled Tomato Juice	Barbecued Beef Cubes (L-18)	Baked Ham (L-69)
Fresh Apple	O'Brien Potatoes (Q-54)	Mustard
Ready-to-Eat Cereal	Buttered Peas (Q-G-1)	Baked Beans (Q-2)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Tossed Green Salad (M-47)	Buttered Green Beans (Q-G-1)
Baked Bacon Slices (L-2)	Vinegar & Oil Dressing (M-72)	Garden Vegetable Salad (M-19)
Hashed Brown Potatoes (Q-54)	Assorted Breads	French Dressing (M-58)
Quick Coffee Cake (D-13)	Butter	Pan Rolls (D-33)
*Toast/Butter	Chocolate Brownies (H-2-1)	Butter
Jam or Jelly	Coffee (C-4)	Sherbet#
Coffee (C-4)	Tea	Chocolate Chip Cookies (H-27)
Tea	Cocoa	Chilled Fruit Cocktail
Cocoa	Iced Tea (C-14)	Coffee (C-4)
Milk	Milk	Tea
		Cocoa
		Grape Lemonade
		Milk

#Omit for Mermiting

MENU XII - WEDNESDAY 20 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Fried Chicken (L-135)	Beef Stew (L-22)
Grapefruit Sections	Gravy (O-16)	Buttered Corn (Q-G-3)
Ready-to-Eat Cereal	Mashed Potatoes (Q-57)	Tossed Vegetable Salad (M-48)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Buttered Carrots (Q-G-1)	Vinegar and Oil Dressing (Q-G-1)
Baked Sausage Links (L-88)	Lettuce Salad (M-32)	Assorted Breads
Hot Cross Buns (D-26-1)	French Dressing (M-58)	Butter
*Toast/Butter	Assorted Breads	Chocolate Pudding (Issued)
Jam or Jelly	Butter	Sugar Cookies (H-27)
Coffee (C-4)	Hermits (H-17)	Coffee (C-4)
Tea	Chilled Pears	Tea
Cocoa	Coffee (C-4)	Cocoa
Milk	Tea	Lemonade
	Cocoa	Milk
	Iced Tea (C-14)	
	Milk	

MENU XIII - THURSDAY 21 August 1975

Breakfast	Dinner	Supper
*Chilled Apple Juice	American Chop Suey (L-151)	Grilled Steak (L-7)
Chilled Grapefruit Sections	Peas & Carrots (Q-G-1)	Baked Potatoes (Q-44)
Ready-to-Eat Cereal	Spring Salad (M-44)	Buttered Green Beans (Q-G-1)
Eggs to Order (F-6 thru F-13)-Away Scrambled	Garlic French Dressing (M-60)	Lettuce and Tomato Salad (M-33)
Baked Ham Slices (L-65)	Assorted Breads	Russian Dressing (M-67)
Home Fried Potatoes (Q-54)	Butter	Pan Rolls (D-33)
Sweet Rolls (D-36-2-3)	Vanilla Wafer Cookies (H-19)	Butter
*Toast/Butter	Chilled Peaches	Ice Cream
Jam or Jelly	Coffee (C-4)	Devil's Food Cake (G-12)
Coffee (C-4)	Tea	Chocolate Buttercream Frosting (G-39 (2))
Tea	Cocoa	Coffee (C-4)
Cocoa	Iced Tea (C-14)	Tea
Milk	Milk	Cocoa
		Iced Tea (C-14)
		Milk

MENU XIV - FRIDAY 22 August 1975

Breakfast	Dinner	Supper
*Chilled Orange Juice	Fried Fish Portions (L-111)	Baked Pork Slices (L-83)
Fresh Banana	Tartar Sauce (O-13)	Applesauce
Ready-to-Eat Cereal	Lemon Wedges	Mashed Potatoes (Q-57)
Eggs to Order (F-6 thru F-13)	Baked Macaroni (F-1)	Buttered Peas (Q-G-1)
Baked Bacon Slices (L-2)	Buttered Green Beans (Q-G-1)	Tossed Green Salad (M-47)
Quick Coffee Cake (A-13)	Tossed Vegetable Salad (M-48)	Vinaigrette Dressing (M-71)
*Toast	Piquant Dressing (M-66)	Radishes
Butter	Corn Bread (D-15)	Assorted Breads
Jam or Jelly	Assorted Breads/Butter	Butter
Coffee (C-4)	Ice Cream	Apple Cobbler (I-53)
Tea	Banana Cake (G-6)	Ice Cream
Cocoa	Bannana Buttercream Frosting (G-59)	Coffee (C-4)
Milk	Coffee (C-4)	Tea
	Tea	Cocoa
	Cocoa	Iced Tea (C-14)
	Lemonade	Milk
	Milk	

MENU XV - SATURDAY 23 August 1975

Breakfast

Chilled Orange Juice
Ready-to-Eat Cereal
Scrambled Eggs (F-13)
Baked Ham Slices (L-65)
Assorted Bread
Butter
Coffee (C-4)
Tea
Cocoa
Milk

APPENDIX D

CONSUMER ACCEPTANCE DATA

TABLE D-1

ON-SITE FOOD ACCEPTANCE RESULTS

	B			L							D			
	8/14	8/21		8/13	8/15	8/18	8/19	8/20	8/21		8/12	8/14	8/18	
Main	6.00	6.29	6.15	5.55	6.83	5.32	5.63	5.57	6.30	5.87	6.20	7.00	7.96	7.05
Cereal	5.70	6.33	6.02											
Sal/Frt	6.53	7.00	6.77	6.16	5.60	5.89	6.67	5.23	6.46	6.00	7.20	6.53	6.38	6.70
Starch	5.69			5.28	5.60	4.00	5.59	5.57	6.00	5.34	5.93	5.92	5.86	5.90
Veg.				6.30	5.69	5.69	6.15	6.08	5.32	5.87	6.55	6.27	6.14	6.32
Bread	6.08	4.17	5.13	6.68	7.47	7.22	6.06	6.92	6.50	6.81	7.18	6.68	6.14	6.67
Bev.	7.11	6.88	7.00	6.67	7.14	7.21	7.00	7.08	7.22	7.05	7.15	7.00	6.59	6.71
Dessert	6.89	6.25	6.57	6.67	6.28	5.94	6.67	5.77	7.08	6.40	7.15	6.68	6.54	6.79
(Menu)	6.46	6.44		6.11	6.57	5.82	6.31	5.08	6.00		5.90	6.83	6.00	

TABLE D-2

REMOTE AREAS FOOD ACCEPTANCE RESULTS

	B	L					D				
	8/21	8/12	8/14	8/18	8/19	8/20		8/13	8/19	8/20	
Main	6.60	4.88	4.60	6.61	3.94	6.75	5.36	5.95	6.50	5.72	6.06
Cereal											
Sal/Frt		6.05	4.41	6.50	5.67	6.19	5.76	5.05	6.33	6.56	5.98
Starch		4.44	4.00	5.80	5.37	6.25	5.17	5.58	4.64	4.63	4.95
Veg.		5.82	5.11	6.13	5.50	6.00	5.71	5.41	5.93	6.54	5.96
Bread	7.00	7.50	6.11	7.33	5.80	5.33	6.41	5.68	7.00	7.00	6.56
Bev.	6.56	6.68	6.17	7.59	6.94	6.94	6.86	5.65	6.93	6.32	6.30
Dessert	5.71	6.47	5.04	5.69	6.44	7.75	6.28	5.47	6.71	6.63	6.27
(Menu)	6.93	5.11	4.21	6.59	4.70	6.50		5.74	6.83	6.56	

TABLE D-3

ON-SITE SERVING TEMPERATURE RESULTS

	B			L							D			
	8/14	8/21		8/13	8/15	8/18	8/19	8/20	8/21		8/12	8/14	8/18	
Main	3.15	3.41	3.28	3.05	3.58	3.31	3.60	3.50	3.28	3.39	3.25	3.00	3.41	3.22
Cereal	3.20	3.00	3.10	2.71	3.25			3.33				2.71		
Sal/Frt	3.00	2.89	2.95	2.74	2.83	2.78	3.00	2.76	2.85	3.00	3.00	2.77	2.73	2.83
Starch	3.31	3.40	3.36	3.11	3.26	3.17	3.64	3.00	3.29	3.25	3.20	3.17	3.16	3.18
Veg.	3.20			3.00	3.26	3.20	3.36	3.40	3.32	3.26	3.20	3.00	3.29	3.16
Bread	3.59	4.13	3.86	2.91	3.05	3.13	3.07	3.00	2.90	3.01	3.20	3.00	3.05	3.08
Bev.	2.96	2.92	2.94	2.70	2.61	2.65	3.00	2.67	2.78	2.74	2.60	2.76	2.96	2.77
Dessert	3.12	3.00	3.06	2.87	2.95	2.87	3.00	3.00	2.92	2.94	2.87	2.79	3.00	2.89

TABLE D-4

REMOTE AREA SERVING TEMPERATURE RESULTS

	B	L					D				
	8/21	8/12	8/14	8/18	8/19	8/20		8/13	8/19	8/20	
Main	3.57	3.63	2.95	3.50	3.31	3.50	3.38	2.84	3.00	2.89	2.91
Cereal			3.50					2.87		3.00	
Sal/Frt		2.67	2.37	2.78	2.63	2.54	2.60	2.56	2.89	2.91	2.79
Starch		2.11	3.17		3.00			2.87	3.22	3.00	3.03
Veg.		3.41	3.11	3.33	3.09	3.58	3.30	2.93	3.13	3.00	3.02
Bread	3.33	3.25	2.47	3.00	3.00	3.29	3.00	3.13	3.00	3.05	3.06
Bev.	3.00	2.26	2.35	2.86	2.50	2.58	2.51	2.35	2.89	2.85	2.70
Dessert	3.00	2.82	2.94	2.85	3.09	3.09	2.96	2.59	3.00	2.85	2.81

TABLE D-5

RESULTS OF FOOD QUALITY SURVEY

	Did you get enough food at your meals yesterday?	Can you go back for seconds?	Do you go back for seconds?	Do you eat more in the field?	Would you rather have had short order meal for this meal?
Remote					
Yes (No.)	66	27*	21*	43	32
Yes %	75	52*	24	45	33
On-Site					
Yes (No.)	101	23*	7*	44	
Yes %	84	34*	6*	34	23

* Significant difference χ^2 test, $p < .05$.

FOOD RATING SURVEY

Date: _____ Meal (Circle One): Brfst. Lunch Dinner

1. Please fill in the items you were served at this meal on the lines provided and rate how good or bad they were by circling the number which describes your opinion. Circle one number in each row.

	Extremely Good	Very Good	Moderately Good	Slightly Good	Neither Good nor Bad	Slightly Bad	Moderately Bad	Very Bad	Extremely Bad
Main Dish:	9	8	7	6	5	4	3	2	1
Cereal or Soup:	9	8	7	6	5	4	3	2	1
Salad or Fruit:	9	8	7	6	5	4	3	2	1
Potato or Starch:	9	8	7	6	5	4	3	2	1
Vegetable:	9	8	7	6	5	4	3	2	1
Bread:	9	8	7	6	5	4	3	2	1
Beverage:	9	8	7	6	5	4	3	2	1
Dessert:	9	8	7	6	5	4	3	2	1

2. Please rate the serving temperature of the foods listed above. Circle one number in each row.

	Much too cold	Too cold	Neither too cold nor too warm - Just right	Too warm	Much too warm
Main Dish:	5	4	3	2	1
Cereal or Soup:	5	4	3	2	1
Salad or Fruit:	5	4	3	2	1
Potato or Starch:	5	4	3	2	1
Vegetable:	5	4	3	2	1
Bread:	5	4	3	2	1
Beverage:	5	4	3	2	1
Dessert:	5	4	3	2	1

3. Finally, please rate the overall menu. How much did you like the combination of foods served for this meal? Circle one number.

9	8	7	6	5	4	3	2	1
Extremely good	Very good	Moderately good	Slightly good	Neither good nor bad	Slightly bad	Moderately bad	Very bad	Extremely bad

4. How did this food compare with other food you have been served in the field in previous years?

This food was:

Much Better	Better	About the Same	Worse	Much Worse
_____	_____	_____	_____	_____

APPENDIX E

MICROBIOLOGICAL PROCEDURES AND DATA

PROCEDURES

MICROBIOLOGICAL ANALYSIS

Food Items

Samples were collected in sterile Whirl-Pak Bags (Scientific Products) and packed in ice in an insulated container for transportation to NARADCOM for analysis. The storage time prior to analysis never exceeded 48 hours and was usually less than 36 hours.

A 40 g portion of each item was placed in a Stomacher bag (A.J. Seward, London, England) and 360 ml of diluent (0.1% Bacto-Peptone, pH 7, Difco Laboratories) added and the contents stomached for 2 min (Stomacher 400, A.J. Seward). Appropriate aliquots were removed and serial dilutions were analyzed by aerobic plate count (APC) using prepoured plates, by the Droplette method (Sharpe et al, Appl. Microbiol. 24: 4-7, 1972) and by use of a Millipore total count water tester (TCWT; Millipore Corp., Bedford, Mass.). The growth medium for the APC and Droplette technique was plate count agar, the incubation temperature for all three methods was 30°C and the incubation time was 48 hours for the APC and TCWT and 24 hours for the Droplette method.

Coliform organisms were enumerated by the most probable number technique of the Bacteriological Analytical Manual for Foods (BAM) of the Food and Drug Administration with the exception that the diluent employed was that described above.

Clostridium perfringens was enumerated in menu items containing meat by the use of SFP agar (Difco Lab) using the method of Shahidi et. al.(Appl. Microbiol. 21: 500-506, 1971).

Water

The microbiological quality of the water in the unit water trailer and in the water sterilizing bag was evaluated with Millipore total count (TCWT) and coliform (CWT) water testers. Incubation for both the total bacteria and coliform counts was conducted in the Millipore portable sampler incubator at 37°C. In certain instances the coliform counts were verified by standard Food & Drug Administration analyses at NARADCOM.

SANITATION

Rodac Plate Count

Rodac plate analysis was conducted with plates prepared by the Baltimore Biological Laboratories and the technique employed has been previously described (Silverman et al, Tech Repts. 75-53-FSL and 75-110-FSL). After use the plates were incubated at ambient temperature for 48-72 hours.

Swab Count

Swab counts were obtained by wetting a cotton swab with a buffered rinse solution (APHA, Standard Methods for the Examination of Dairy Products, 1972), swabbing a 4 in^2 (25.8 cm^2) surface area 25 times each in two directions at right angles to each other and then placing the swab into 20 ml of the 0.1% peptone diluent, pH 7.0. After shaking the tube 50 times, 18 ml of the diluent was analyzed for its microbial concentration with a TCWT and CWT, incubation usually being 48-72 hours at ambient temperature for the TCWT and 24 hours at 37°C for the CWT.

Mess Kit Gear

The pan of the mess kit was evaluated at the experimental kitchen tent. With the exception of a small number the personnel did not generally dip the gear in a hot water rinse and no attempt was made to control this variable.

In the field both the pan and canteen cup of the mess kits were evaluated microbiologically. The pan by Rodac plates and the cup by a swab count of the inner surface of the cup above the rivets or weld which secures the swivel hinge to which the handle was attached. Evaluation of the mess kits in the field were conducted before their subjection to a hot-water dip normally done prior to their use.

TEMPERATURE

Temperatures of the food items during preparation and at serving, the water in the pot and pan washing operation, the water in the mess kit laundry line and ambient temperatures were taken mainly with a Model 392 Wahl digital thermometer (W. Wahl Corp.) employing a platinum sensor. To supplement the digital thermometer a calibrated Weston dial thermometer (Model 2292) was also employed.

TABLE E-1

MICROBIOLOGICAL ANALYSES OF COOKED AND RAW MENU ITEMS

	Percentage Aerobic Plate Count (CFU/g)[a]							
	Total	$\leq 10^2$	$\leq 10^3$	$\leq 10^4$	$\leq 10^5$	$\leq 10^6$	$\leq 10^7$	$\leq 10^8$
Entree[b]	28	89	93	100	-	-	-	-
Cooked vegetable	4	75	100	-	-	-	-	-
Salad	18	0	0	0	0	61	94	100
Salad dressing	2	0	0	0	100	-	-	-

	Coliform Count (MPN/g)				
	Total	$\leq 10^0$	$\leq 10^1$	$\leq 10^2$	$> 10^2$
Entree	28	89	96	100	0
Cooked vegetable	4	100	-	-	-
Salad	18	6	11	22	78
Salad dressing	2	100	-	-	-

[a]Determined by the plate count method using prepoured plates, plate count agar and incubation of 30°C-48 hr.

[b]Also included scrambled eggs served at breakfast.

TABLE E-2

RODAC PLATE EVALUATION OF SURFACES IN THE COOKING, SERVING AND POT/PAN WASHING FACILITIES

	No. Times Tested	Percent Satisfactory[a]
Pan, large for field oven and serving	17	71
Pan, shallow, large for field oven	6	83
Pan, small	1	100
Pan, small, deep	3	67
Pan, baking	6	80
Pot, 15-gal	13	69
Pot lid, 15-gal pot	7	87
Pot, tapered	4	50
Bowl, large, round bottom	3	67
Table - preparation area	14	0
Table - serving area	21	10
Table - for Mermite can portioning	7	0
Shelf - pot and pan tent	4	0
Slicer, meat	2	0
Cutting board	13	8
Spatula, long handle	4	0
Serving spoon, slotted	1	100
Dipper	10	20
Ladle	4	50
Rolling pin, wooden	1	0
Mermite - container	22	32
Mermite - insert can	27	33
Mermite - insert can lid	2	100
Total	192	37

[a] Based on the definition of satisfactory as half or more of the Rodac plates not exceeding 50 CFU/plate and none exceeding 100 CFU/plate.

TABLE E-3

EVALUATION OF MESS KIT MEATPAN BY RODAC PLATES

Date	Meal	Location	No. Tested	⩽50	⩽75	⩽100
11-8	Supper	Kitchen Tent	20	60	75	80
12-8	Supper	Kitchen Tent	20	90	90	95
13-8	Dinner	Field	49	92	98	98
13-8	Supper	Field	42	76	81	86
14-8	Breakfast	Field	26	65	77	81
Total			157	79	86	89

TABLE E-4

EVALUATION OF MESS KIT CUPS BY THE SWAB TECHNIQUE

			Percentage[a]							
Date	Meal	No. Tested	⩽100	⩽200	⩽300	⩽400	⩽500	>500	>1000	>2000
13-8	Dinner	17	18	29	41	47	47	53	53	53
13-8	Supper	8	38	50	63	63	63	38	25	25
14-8	Breakfast	7	0	0	0	0	0	100	57	43
Overall		32	19	28	38	41	41	59	47	44

[a] Based upon CFU/25.8 Cm^2 (4 in^2).

TABLE E-5

A COMPARISON BETWEEN VISUAL AND RODAC EVALUATION OF SURFACES

	Number of Surfaces Evaluated	Percentage[a] Satisfactory as Evaluated by Rodac Plates		Unsatisfactory as Evaluated by Rodac Plates	
		Visually Satisfactory	Visually Unsatisfactory	Visually Satisfactory	Visually Unsatisfactory
All Surfaces	172	82	17	74	26
-Minus SS[b] Tables	138	83	18	67	31
-Minus Mermite Cans	123	83	17	75	25
-Minus SS Tables and Mermite Cans	89	85	17	63	35

[a]The percentage was obtained with Rodac analysis as the denominator.

[b]Stainless steel.

TABLE E-6

A COMPARISON BETWEEN SWAB AND VISUAL EVALUATION

	CFU/Swabbing					
	0-100	101-200	201-500	501-1000	1001-1500	>1500
Number	9	11	17	14	8	17
Visually[a] - Satisfactory	3	9	12	11	5	14
Visually - Unsatisfactory	6	2	5	3	3	13

[a]Satisfactory - no food particles, soap film not excessive.

TABLE E-7

TEMPERATURE COMPLIANCE OF FOOD ITEMS SERVED IN THE EXPERIMENTAL KITCHEN TENT

Item	No. Observations	Percentage Complying[a]	Noncomplying
Entree	14	50	50
Cooked Vegetable, Potato	13	85	15
Gravy	5	100	0
Salad, Raw Vegetable	14	7	93
Salad Dressing	3	0	100
Dessert	4	0	100
Overall	53	45	55

[a] For cooked menu items the serving temperature should be $\geq$140°F (60°C) and at $\leq$55°F (13°C) for chilled menu items.

TABLE E-8

TEMPERATURE COMPLIANCE[a] OF FOOD ITEMS WHEN PLACED INTO MERMITE CANS AND WHEN SERVED IN THE FIELD

Item	Placed Into Mermite Cans (Kitchen)			Served From Mermite Cans (Field)		
	Number of Observations	Percentage Satisfactory	Percentage Unsatisfactory	Number of Observations	Percentage Satisfactory	Percentage Unsatisfactory
Entree	13	69	31	13	54	46
Cooked Vegetable, Potato and Rice	6	100	0	16	62	38
Gravy	-	-	-	1	0	100
Salad, Raw Vegetable	11	18	82	10	0	100
Dessert	1	0	100	3	33	67
Egg, Scrambled	2	50	50	2	50	50
Milk	-	-	-	7	86	14
Ice Tea	-	-	-	1	100	0
Juice	-	-	-	1	100	0
Overall	33	55	45	54	50	50

[a]Cooked items should be served at 140°F (60°C) or higher, chilled items at 55°F (13°C) or lower, and served within 3 hr.

TABLE E-9

TEMPERATURE OF THE WATER USED IN THE POT, PAN AND UTENSIL WASHING AND SANITIZING OPERATION

Stage	Number of Observations	°F / °C	Incidence ≤120 / ≤49	121-140 / 50-60	141-160 / 61-71	161-180 / 72-82	>180 / >82
Wash	18		2	2	7	6	1
Rinse	18		2	2	6	7	1
Final Dip	18		1	2	3	12	1

APPENDIX F

MESS GEAR AND EQUIPMENT DATA

TABLE F-1

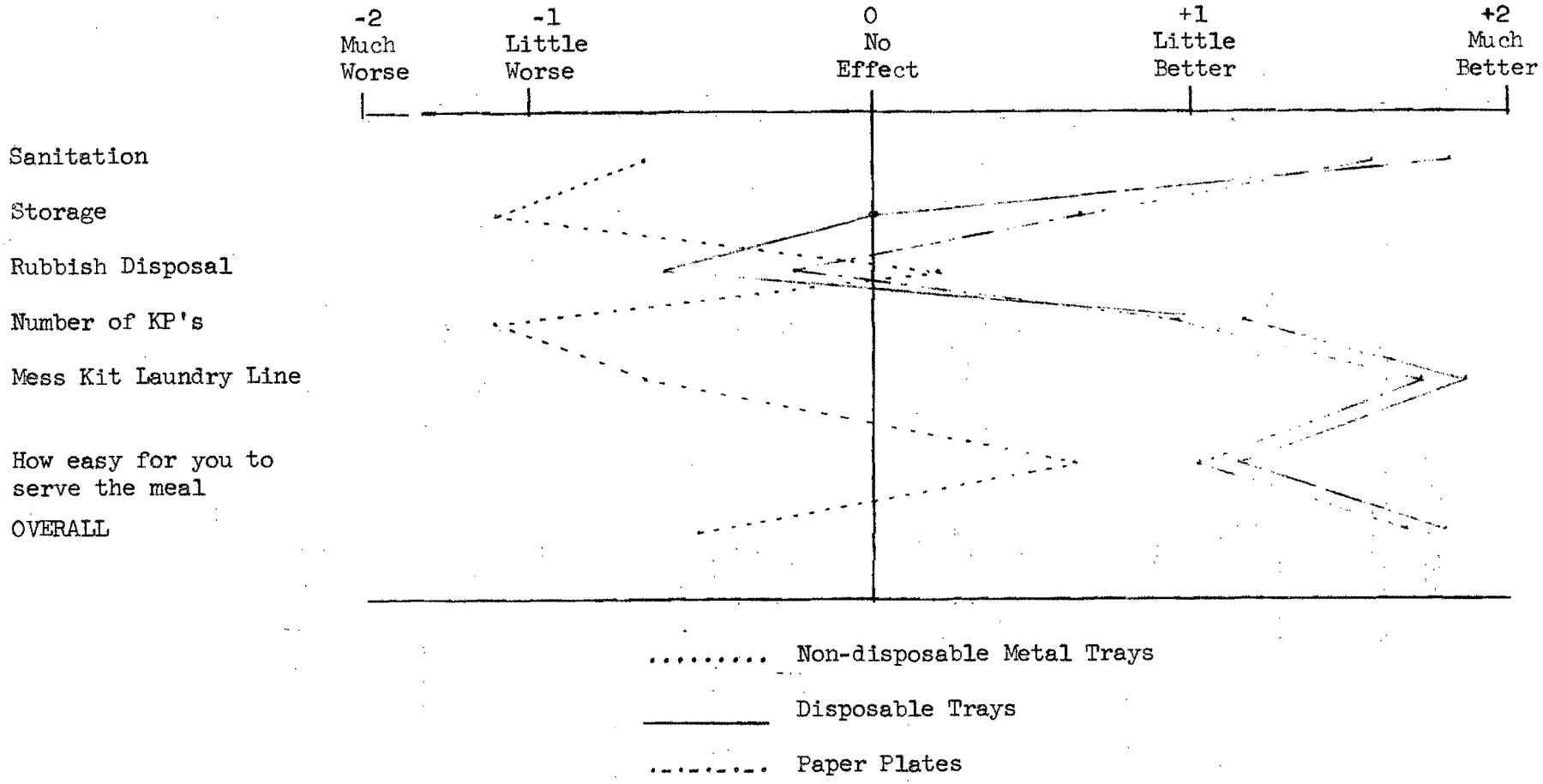
COMPOSITE SCORES OF CONSUMER MESS EQUIPMENT SURVEY*

Plate	Standard Mess Kit	Non Disposable Tray	Disposable Tray	Paper Plate
a. Sanitation	- 61	- 30	+ 77	+ 51
b. Easy to Clean	- 59	- 34	+ 66	+ 49
c. Amount of Space for Food	- 58	+ 22	+ 74	- 39
d. Easy to Carry Filled	- 31	+ 32	+ 69	- 45
e. Easy to Cut on It	- 27	+ 32	+ 58	- 36
f. Food Stays Hot	- 5	+ 13	+ 37	+ 9
g. Overall Acceptance	- 73	- 18	+ 70	- 13

Eating Utensils	Mess Kit Knife, Fork & Spoon	Dining Facility Knife, Fork & Spoon	Plastic Knife, Fork & Spoon
a. Sanitation	- 59	- 1	+ 74
b. Easy to Clean	- 50	- 10	+ 50
c. Size of Knife, Fork & Spoon	+ 16	+ 42	+ 57
d. Easy to Cut With	+ 4	+ 35	+ 23
e. Overall Acceptance	- 51	+ 17	+ 58

Drinking Cups	Metal Canteen Cup	Paper Cup
a. Sanitation	- 62	+ 75
b. Easy to Carry	- 11	+ 57
c. Easy to Fill	+ 33	+ 62
d. Large Enough	+ 53	+ 14
e. Easy to Clean	- 53	+ 68
f. Overall Acceptance	- 34	+ 64

* Score is the sum of the responses derived by weighting an acceptable (+) response as +1, an unacceptable (-) response as -1, and an uncertain (?) response as 0.



* Response to question, "If --- were substituted for the standard metal mess kit, how would it affect the following areas?"

Figure F-1. Food Service Worker Mess Equipment Evaluation*

MESS GEAR USER SURVEY

MEAL (Circle): Breakfast Lunch Dinner

Date:_____

Please rate the mess kits (flatware), eating utensils (knife, fork, spoon) and drinking cups by using the following method.

If an item would be acceptable for one category (for example, sanitation) then place a "+" on the line.
If the item would be unacceptable for that category, then place a "-" on the line.
Use a "?" if you are uncertain, but be sure to place one of the signs, "+", "-", or "?" in each space.

For example, if in your opinion, the standard metal mess kit is acceptable for sanitation, you would write in a "+" under mess kit and on the line for sanitation. If you were not certain about sanitation for the non-disposable tray, you would write in a "?" under non-disposable tray and on the line for sanitation, and if it were unacceptable you would write in a "-".

1. FLATWARE	Standard Mess Kit	Non Disposable Tray	Disposable Tray	Paper Plate
a. Sanitation				
b. Easy to Clean				
c. Amount of Space for Food				
d. Easy to Carry Filled				
e. Easy to Cut on It				
f. Food Stays Hot				
g. Overall Acceptance				

2. EATING UTENSILS	Mess Kit Knife, Fork & Spoon	Dining Facility Knife, Fork & Spoon	Plastic Knife, Fork & Spoon
a. Sanitation			
b. Easy to Clean			
c. Size of Knife, Fork & Spoon			
d. Easy to Cut With			
e. Overall Acceptance			

3. DRINKING CUPS	Metal Canteen Cup	Paper Cup
a. Sanitation		
b. Easy to Carry		
c. Easy to Fill		
d. Large Enough		
e. Easy to Clean		
f. Overall Acceptance		

Please make sure you place a "+", "-", or "?" in each space

+ = ACCEPTABLE
- = UNACCEPTABLE
? = UNCERTAIN

APPENDEX G

FOOD SERVICE WORKER AND HUMAN ANALYSIS DATA

FIGURE G-1

Mean Worker Responses to Two Kitchen Arrangements

	1 Very Bad	2 Bad	3 Slightly Bad	4 Neither Bad nor Good	5 Slightly Good	6 Good	7 Very Good
Bumping into other cooks while working	.	1.	.	.	.	2 .	.
Size of kitchen	.	.	1 .	.	.	. 2	.
Temperature	.	1 .	.	.	2	.	.
Safety	.	.	1 .	.	.	2 .	.
Smoke and steam	.	.	1 .	.	.2	.	.
Ease of preparing meal	.	.	. 1	.	.	2.	.
Amount of storage space	.	.	.1	.	. 2	.	.
Ease of getting supplies stored in kitchen	.	.	. 1	.	. 2	.	.
Ease of cleaning up	.	.	.	1	.	2.	.
Ease of serving customers in line	.	.	.	1	.	2 .	.
Place to fill insulated containers	.	.	. 1	.	2	.	.
Ease of preparing this summer's menus	.	.	.	1 .	. 2	.	.
How easy would it be to move the kitchen	.	.	. 1	. 2	.	.	.
Sanitation	.	.	.	1	. 2	.	.
Lighting	.	.	.	. 1	. 2	.	.
How long customer waits in line	.	.	.	. 1	. 2	.	.
Noise	.	.	.	. 1	. 2	.	.
Insect control	.	.	.	. 1 2	.	.	.
OVERALL	.	.	. 1	.	.	2.	.

KEY: 1 = First week arrangement 2 = Second week arrangement

TABLE G-1

Effective Temperatures (F) in XM-1975 Kitchen Tent

DAY AND TIME	AMBIENT SHADE	AMBIENT SUN	TENT[1] LOWEST	TENT[1] HIGHEST	TENT[2] ROOF
12 Aug 1040	77.0	80.0	79.0	81.5	84.0
12 Aug 1625	77.5	78.0	79.0	85.0	79.0
13 Aug 1115	78.0	79.5	78.0	82.5	84.0
14 Aug 1335	76.5	76.5	76.0	86.5	85.5
15 Aug 1200	71.0	73.5	71.5	74.0	71.5
18 Aug 1335	74.0	76.5	74.5	76.5	75.0
19 Aug 1035	68.0	72.0	68.5	72.5	70.0
20 Aug 1550	71.5	72.0	73.5	78.0	--

MIL-STD-1472B specifies a maximum of 85°F, effective temperature for prolonged exposure.

[1]Temperature measured at six positions in tent at waist level. Lowest and highest readings presented.

[2]Temperature measured at 8 foot height near roof of tent.

DEPARTMENT OF THE ARMY
US ARMY NATICK RESEARCH and DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS 01760

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DoD-314

US Army Representative
Joint Technical Staff,
for DOD Food RDT&Eng Program